Caste as an Impediment to Trade*

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Abstract

We compare outcomes across two types of villages in a poor region of rural India. The two types of villages systematically vary by which caste is *dominant*, i.e., the caste group which owns the majority of land. The *dominant* caste is either from an upper caste or a lower backward caste. The key finding is that income is substantially higher for low caste households residing in villages dominated by a low caste. Many of the usual factors which have previously been thought to adversely effect groups with high social distance: public good provision, political economy considerations, and exploitative tenancy or credit relations, do not seem to be important here. Instead, it is found that social distance reduces economic welfare due to a trade break-down across caste groups; thus precluding the efficient functioning of markets. Specifically, trade in irrigation water across castes seems to be difficult to maintain even though the potential gains from trade are huge. All else equal, lower caste water buyers have agricultural yields which are 45% higher if they reside in a village where water sellers are of the same caste compared to one where they are not.

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1. Introduction

This paper compares outcomes across two types of villages in a poor region of rural India. We exploit dramatic village level variation in caste composition that is historically and exogenously determined, remaining essentially unchanged for centuries. Villages vary markedly by the identity of their *dominant* caste group.[1] The notion of a *dominant* caste comes from the sociological and anthropological literatures. M.N. Srinivas (1955) first defined the term "dominant caste" to refer to the caste in the village which is numerically strong and also wields preponderant economic and political power. Dumont (1970) later insisted that dominance arises solely from economic power rather than factors like numerical preponderance, and that this power flows exclusively from control of land. This latter definition of caste dominance is the one used here; dominant caste refers to the caste group which owns the majority of land.

Approximately 48% of the Hindu villages in the sample are dominated by an upper caste and 42% are dominated by a lower backward agricultural caste (BAC). The differences across village type are dramatic: in the BAC dominated villages there are almost never upper caste households present. Upper caste dominated villages, in contrast, include all main caste groups in the sample: upper castes, backward agricultural castes (BAC), other backward castes (OBC), and scheduled castes (SC).[2] The analysis compares outcomes of lower caste (BAC, OBC, SC) households residing in both types of villages. Income is systematically and substantially higher for low caste households residing in villages dominated by BACs, and the aim of this paper is to understand why.

It is not that surprising to find that some measure of social fragmentation could significantly impact individual well-being. The variation in caste dominance exploited here could be thought to imply ethnic heterogeneity: the villages where the upper castes are also present (the upper caste dominated villages) are more ethnically heterogeneous than those where only lower castes reside (the BAC dominated villages). A large literature has demonstrated a negative correlation between ethnic diversity and economic outcomes, consistent with the findings here.[3] It is commonly conjectured that more ethnically diverse communities have greater difficulty sharing public goods

[1] All Hindus, the major religious group in India, are divided into a number of hereditary caste groups. The emergence of the hierarchical caste system dates back to the Aryan Invasion (1500 BC). Long-standing rules govern interaction within and across caste groups. These include strict endogamy and restrictions on the sharing of food and drinking water and other social interactions (see, Dumont 1970).

[2] The BAC and OBC categories are broadly both from the middle-ranking caste in the overal hierarchy. The BAC group are the traditional farming castes, and the OBC group are the traditional artisan castes. The BAC group is ranked higher than OBC. The SC are the lowest in the caste ranking, formerly known as the untouchable castes.

[3] Refer to Alesina and La Ferrara (2005) for a summary of this literature.

and resources, and are less able to impose social sanctions that prevent collective action failures.[4] Previous empirical work particular to India has demonstrated that ethno-linguistic fragmentation, applied to caste and religious divisions, negatively correlates with access to public goods (Banerjee and Somanathan 2004, Banerjee, Iyer, and Somanathan 2005).

An alternative view, particular to India, which also suggests these findings may not be surprising, stems from the hierarchical Indian social structure. The traditional village economy revolved around the hereditary caste hierarchy which was a primary determinant of an individual's occupation. Upper castes were the land owners; middle ranked (backward) castes the farmers and artisans; and the lowest ranked (scheduled) castes the labourers and those responsible for other menial tasks.[5] Given these historical patterns, the finding that lower castes fair better in villages where no upper castes are present may not seem surprising. We might well expect that, via tenancy or credit relations, upper caste landlords are able to exploit the lower, thus making them worse off in comparison with those living in villages where land is exclusively owned by lower castes.

The empirical analysis here, however, does not support low public good access or exploitative tenancy or credit relations as explanations for the large losses visited upon lower castes residing in high caste dominated villages. Moreover, these losses do not appear to be related to the political economy environment where we might expect a breakdown in village level cooperation or law enforcement in villages with more social fragmentation.

The intriguing finding here is that the main cause of poorer low caste outcomes in high caste dominated villages appears to be a pervasive breakdown in the functioning of private groundwater markets. These markets are ubiquitous and highly important in arid areas but the empirical results suggest that upper caste water sellers are unable to easily trade with lower caste water buyers. As a result, in villages where the dominant caste, who own the majority of the private groundwater extraction mechanisms, is an upper caste, there appears to be a severe inefficiency in the distribution of groundwater. The implications of this break-down in trade for the low-caste in this poverty stricken part of India are dramatic: all else equal, lower caste water buyers have agricultural yields which are 45% higher if they reside in a village where the majority of water

[4] See, Alesina and La Ferrara (2005) for references.

[5] Traditionally, the upper caste land owning class did not cultivate their land themselves. These castes comprised the *jajman* who were linked through the *jajmani* system with the farmer and artisan castes (now classified as the backward castes) and the service castes (now classified as the scheduled castes). The centuries old *jajmani* system was a reciprocal arrangement between the hereditary farming, artisan, and service castes and the higher landholding castes. The lower castes (*purjans*) provided labour, goods, and services to the upper castes (*jajmans*) in return for land and food. By and large, the traditional reciprocal system of exchange is no longer in place in village India, though the hereditary caste rankings persist. However, it is often still the upper castes who own the land and hire lower caste members as cultivators. See, Beteille (1996), Srinivas (1976), and Marriott (1955).

sellers are of the same caste compared to one where they are not.

The findings here can be interpreted as an example of when social distance (the caste system) directly affects the efficient operation of markets.[6] In the light of previous research this is again not too surprising. Others have examined how the organization of society and its social and moral enforcement institutions may impact its economic performance.[7] The capacity to sustain self-enforcing and mutually beneficial outcomes, where there are multiple equilibria, is something that is likely affected by pre-existing attitudes of trust (or distrust), and it is not surprising that where there are large social affinities (through caste) these are more likely to function smoothly.[8] However, an advantage of markets is that these do not, at least at first pass, depend on altruism or trust to make participants mutually better off. Adam Smith's famous dictum is an early statement of the well-known principal that in properly functioning markets individual pursuit of self-interest without regard to wider social welfare should ensure socially improving outcomes. This has been tempered by the realization, however, that few markets are perfect, and, where contracts are incomplete, even the mere possibility of mutually beneficial trade may require individuals to trust that trading partners will not act overly-opportunistically.[9] This paper provides some empirical support that significant trading opportunities can remain unrealized due to social or cultural distance. This seems important for attempts to accord notions like social capital centre stage in understanding the functioning of markets (as some recent literature has done).

Relative to trade in complex, heterogeneous, quality varying goods or services, trade in private water markets should be relatively simple. Such trade usually consists of a simple bilateral agreement between two individuals residing within close proximity (a proximity usually shared by their families for generations). The evidence for trade break-down presented here is striking, particularly as the documented gains from trade are enormous, and is at least suggestive that underlying trust may be crucial in the development of markets in other contexts.

[6] Akerlof (1976) demonstrates how sanctions of a caste system can prevent efficient outcomes in a theoretical framework. With the use of experiments, Hoff and Pandey (2004) find that when caste identity is public information, low-caste subjects anticipate thier effort will be poorly rewarded.

[7] See, for example, Platteau (2000) and Francois (2002) who both survey this literature. Recent work by Tabellini (2005), provides an attempt to empirically investigate the effect of culture on economic development in a cross-country setting.

[8] Greif (1994), for example, demonstrates how cultural differences across two pre-modern societies lead to stark differences in trading patterns. In a similar vein, Kranton (1996) derives conditions under which reciprocal exchange (informally enforced trade) persists despite the possibility of more efficient market alternatives. Using survey data of agricultural traders from three African countries, Fafchamps and Minten (2001) find that traders with more social contacts have higher output.

[9] Platteau (2000) stresses the idea that in traditional societies, codes of good conduct and honest behavior are often confined to small circles, and that movement towards a more modern market economy requires the diffusion of generalized moral codes.

The identification strategy of the empirical analysis for this paper relies on village level variation in caste composition. It is therefore crucial to establish the exogeneity of this variation. The next section of the paper provides extensive historical evidence supporting this exogeneity. Section 3 discusses the overall data and undertakes raw comparisons of outcomes across the two types of villages (upper caste dominated versus BAC dominated). Empirical estimations at the household level in Section 4 point to the importance of private groundwater markets in explaining the differences across village types. A more in-depth analysis of groundwater markets is subsequently undertaken in Section 5. This being said, we have only limited information on groundwater transactions and support for our favored interpretation of a trade break-down across caste groups is partially demonstrated by the lack of support for alternative explanations in the data. Ruling out these alternative interpretations forms the discussion of Section 6 and Section 7 concludes.

2. Village Caste Composition

This study rests on the observation that within village caste composition varies across villages located in the same region of northeast India, the two bordering states of Uttar Pradesh and Bihar. There are essentially two dominant castes in this region. Approximately 48% of the Hindu villages in the sample are dominated by (i.e., the majority of the land is owned by) an upper caste (Brahmin or Rajput (Thakur)), whereas 42% are dominated by a backward agricultural caste (Yadav (Ahir)).[10] Villages in India are typically multi-caste, with no two villages being identical in either the number of castes or in the numerical strength and wealth of each resident caste (Srinivas 1987).[11] For example, in Uttar Pradesh an average village with 150 to 300 households may have 15 to 25 castes represented in its population (Ahmad and Saxena 1994). The dominant caste is usually, though not always, a higher ranking caste. Moreover, a given caste group may occupy different positions in neighbouring villages (Srinivas 1987). This is the case in the data used here. The backward agricultural Yadav caste are dominant in close to half of the villages under study, whereas the other half are dominated by an upper caste group. In this region, examples of dominance by non-upper castes are not atypical. Sahay (2001), for example, studies four villages in Central Bihar; one is dominated by Brahmins (an upper caste), another by Rajputs (an upper caste), and the remaining two by Koiris (a backward agricultural caste). Shanker (1988) studies a sample of 100 villages in Uttar Pradesh and Bihar and finds similar variation; villages are either

[10] The predominantly hindu villages make up 89% of the total sample, the remaining villages are instead dominated by a Muslim caste.

[11] Refer to, amongst others, Srinivas (1987), Mandelbaum (1970), and Marriott (1955).

dominated by an upper caste (Brahmin, Rajput) or a backward agricultural caste (Kurmi, Koiri, Yadav). Jha (1991) analyses documentation from the early 1900s on the caste composition of 5475 villages located in Bihar and finds that approximately 30% of the villages have no upper caste members in residence.[12]

The origins of the distribution of caste groups at the village level is a difficult to answer historical question. In general, village case studies reveal that we often need to look back hundreds of years to determine the origins of the caste composition specific to that village.[13] According to surveys, larger castes like Brahmins, Rajputs (Thakurs), and Yadavs tend to be evenly spread throughout both Uttar Pradesh and Bihar.[14] Settlement of this area can be traced back many centuries to Aryan occupation.[15] According to Metcalf (1979), basic elements of the village system and various cultivating castes, such as the Yadavs and Kurmis (both BACs under today's classification), were established early in the sixth century. During subsequent centuries, cultivation slowly extended across the fertile plains. These resident cultivators, together with their artisan (now classified as OBCs) and untouchable dependents (now SCs), generated the wealth that sustained society.[16] Members of the non-cultivating Brahmin caste (priests) were also present in the villages. The Muslim invasion of western India, beginning in the twelfth century, lead to a mass arrival of dispossessed Rajput colonies into the region. During the next three centuries these Rajput exiles successfully spread. By the time the British arrived in the late eighteenth century, the Rajput caste owned and controlled the majority of the land. Under colonial rule, the *Zamindari* system of land tenure was in place in Uttar Pradesh and Bihar.[17] The position of the *zamindars* (landlords) was

[12]See also, Mendelsohn (1993), Siddiqui (1993), and Shukla (1976).

[13]For example, in the case of Palanpur, a village in western Uttar Pradesh, some two hundred years ago, there resided a *raja* of the Thakur caste with lower Murao caste tenants cultivating his land. Upon the marriage of his two daughters, the raja evicted some of his tenants to give some land to his Thakur sons-in-law. This is the story told for why Palanpur today is a Thakur dominated village with a strong presence of Murao cultivators (Dreze et. al. 1999). A few Brahmins once resided in the village but were wiped out be an epidemic long before the survey period (1957-8) (Dreze et. al. 1999). Danda (1987) conducts a village study in northwest Uttar Pradesh, where he explains that the current co-existence of Muslims and hindus in the village. The present site of the village was first occupied by a hindu family, that came from somewhere in the southwest, more than 600 years ago. A later member of the family converted to Islam and married out of caste. The Muslim part of the village maintains these origins and follow the caste of that out of caste marriage.

[14]These proportions by caste are according to the 1931 Census, which is the last national Census with detailed information on caste groupings (see, Ahmad and Saxena (1994), and Schwartzberg (1965)).

[15]The Aryan Invasion dates to 1500 BC.

[16]Chamars, the largest scheduled caste group in the area, and in the data, are also accordingly spatially widespread in present day (see, Ahmad and Saxena (1994), and Schwartzberg (1965)).

[17]Zamindars during the Mughal period of India (1526 - 1756) denoted rent collectors from the cultivators. Although zamindaris were allowed to be held hereditarily, the holders were not considered to be the proprietors of their estates. The government always received the right to forfeit the rights of the zamindar in the case of bad conduct. Under the colonial regime the zamindars were declared proprietors of land who paid revenue to the government. The zamindari property could be freely transferred or mortgaged without taking sanction from the authorities.

initially determined by their pre-colonial history of domination and the zamindars mainly comprised members of the Rajput caste. New regulations during the colonial period initiated a slow decline of Rajput territorial power and opened up zamindari rights to members of the Brahmin caste, and occupancy rights to the cultivating castes, such as the Yadavs.[18] The land ownership of zamindars varied significantly and often, due to extremely large landholdings covering several villages, these high caste landlords were absentee and resided elsewhere.[19] The Zamindari Abolition, which took place just after independence in the early 1950s, stripped the zamindars of all of their landholdings except that which they had kept unlet as "home farms" or as grove land, and as a result abolished the large scale absentee landlordism. These land rights were transferred to the former permanent tenants (generally the BACs). Abolition subsequently gave rise to a new class of landowners comprised mainly of the BACs.[20] The principal losers were the Rajputs, however, in spite of these major shifts, substantial land remained under the control of the upper castes.[21]

Consequently, the 1950s saw a significant land redistribution across caste groups, though the actual land being cultivated by a given caste did not change. Since then, changes in land ownership and distribution have been mainly driven by the process of inheritance and partition, with the combined ownership of each dynasty remaining fairly constant. The land endowment of a particular household has depended far more on the division of land within that dynasty (generally divided amongst the sons) than between dynasties. Formal sales of land are rare. An in depth village study has been performed by Dreze et. al. (1999), for the village of Palanpur. The amount of land sold each year in Palanpur, between 1957-1993, amounts to only half of 1% of the total village land. Similar turnover rates emerge from data for other villages in western Uttar Pradesh, for the ICRISAT villages, and villages in West Bengal (see, Dreze et. al. (1999) for references).[22]

There have been no other successful land reforms other than the Zamindari Abolition and no significant land sales in the area.[23] Moreover, given the strict rules which govern the hereditary

[18] Permanent tenants could also be from the higher castes, Rajput or Brahmin. In the case where the tenants were of the same caste as the zamindar, they were usually of a different clan. These high caste tenants did not typically till the soil themselves, they employed lower caste share-croppers. This second group of tenants, usually from the scheduled castes, had no customary or fixed rights to the land.

[19] Metcalf (1967), for example, discusses holders of estates comprising from 50 to 350 villages.

[20] An example of this transformation is illustrated for Palanpur, in western Uttar Pradesh, by Dreze et. al. (1999). There, during the British rule, the village land was in the hands of three zamindars (two Thakurs and one Brahmin), all of whom lived in other villages. The lower caste Muraos were the ones who cultivated the land. At the time of the abolition of zamindari, land which was leased out by the Thakurs was transfered to former tenants, the Muraos.

[21] See, for example, Jain (1996), Ahmad and Saxena (1985), Hasan (1989), and Singh (2003).

[22] A more active land market can develop in some circumstances. For example, from large scale rural-urban migration or the development of non-agricultural opportunities in rural areas, as has occurred in some parts of South India (see Dreze et. al.(1999) for references).

[23] The Zamindari Abolition was successful in putting land into the hands of the backward agricultural castes but

caste rankings, there is virtually no mobility of individuals across the different caste groups. As recently analysed by Munshi and Rosenzweig (2005), there is also very little caste based migration in India. Women will migrate to different villages for the purpose of marriage within caste groups, however, men seldom do and instead remain with their paternal family in their natal villages. This is primarily due to the reliance on sub-caste networks of mutual insurance which do not transgress village boundaries (Munshi and Rosenzweig 2005). In general, there is relatively little mobility in India. According to the 1991 and 2001 censuses, approximately 24-29% of the Indian population are migrants, where 60% of the migrants move within the same district, and 25% migrate within the same state. In the states of Bihar and Uttar Pradesh, 24% and 21% of the population are migrants respectively. For both states, the majority of migrants are women migrating to other rural areas within the same district for the purpose of marriage. In Bihar, 94% of the migrants are in rural areas, and 89% of migrants are female. For Uttar Pradesh, the respective numbers are 87% and 85%.[24] Table 1 lists the proportion of the population who are migrants, into the districts of Bihar and Uttar Pradesh where the current data is from, using corresponding data from the 1931, 1951, and 1991 censuses of India. The first column reports the proportion of the population who are migrants from another district within the same state, and the second column are those from other states in India. We see from this table that these migration rates by district have not changed dramatically over time. This table reports the migration rates into the different districts of interest. For the case of Bihar, the early census data also reported the movement from one district to another. Table 2 lists the proportion of the population who have moved to another district within the state, thus reflecting out-migration rates from the different districts. We see that these rates also did not significantly change between 1931 and 1951.[25]

The Zamindari Abolition seems to play a key role in explaining why we observe two dominant land owning castes in the villages of our area of study. Land is in the hands of lower caste groups (BACs) in some villages because historically there were no higher caste households residing in these villages, instead higher caste members were absentee landlords who lived elsewhere.[26] Though there

has done nothing for the position of the lower scheduled castes.

[24]Rural-urban migration constitutes only one sixth of migration in India. It is even lower in Uttar Pradesh and Bihar, which are low urbanized states relative to the national average. It is predominantly poor young men who migrate to the urban areas in search of employment.

[25]Further evidence against migration patterns explaining the main empirical finding that low caste individuals are better off in low caste dominated villages compared to those dominated by a higher caste comes from looking to the village and household level data in our sample. There we do not find any significant differences in terms of remittances or distance to nearest town across the two types of villages.

[26]It is also possible that, in some cases, Yadav castes historically owned the land. For example, Hasan (1989) reports that BACs owned 6% of the land in Uttar Pradesh pre-Independence. Shukla's (1976) village study from

is still an econometric concern that there are systematic, unobservable differences across these two types of villages, it seems clear that the caste composition of the villages under question has not changed systematically for some time. To check this, though there is no historical village level data, we can compare the caste composition by district of the current data to that of the 1921 Census, to confirm that the overall caste composition has not altered substantially. The current data reports the top seven castes, in terms of population, in each village. We aggregate these numbers up, in terms of proportion, relative to the total population, by district, and compare these proportions to those for the identical caste groups reported by district in the 1921 Census. Table 3 lists these comparisons aggregated up by caste classification, i.e., upper caste or backward caste.[27] It must be noted that this is quite noisy data. First, the district boundaries do not correspond in the sense that the 1921 Census districts are larger and encompass more than one district in the current data. As a result, the current data may oversample certain districts relative to the Census data. Second, we were not able to match up all castes, that is, some of the castes reported in the current data are not represented in the Census data.[28]

We should expect the proportions of each caste group to change across the different time periods. For one, there are likely differential birth rates by caste and also there was an overall increase in the proportion of Hindus within some districts as significant Muslim populations emigrated to the newly created Pakistan around India's Independence in 1947. We see from Table 3 that there is substantial caste variation across districts. Despite the noise in the data, the numbers match up quite well within districts across the two data sets, in particular the ratio of upper castes to backward castes is fairly consistent across data sets. Exceptions are: Champaran and Purnea (in Bihar) and Allahabad, Faizabad, and Gorakhpur (in Uttar Pradesh). In these cases, the percentage of upper castes has fallen across time relative to the percentage of backward castes. In most of these cases, the upper castes are represented by a single caste, Brahmin, whereas the backward castes group is made up of 7-12 caste groups. It is consequently not that surprising that the data

Bihar uses historical records to date the origins of the present-day Yadav caste dominance back to the Mughal period, when the original Rajput mortgaged the estates to a Yadav caste member who subsequently transferred them by sale to another Yadav caste member in 1600. Yadava (1971) similarly provides an example of a Yadav dominated village, located in North India, dating back to the seventh or eighth century.

[27]Note for clarification that I only matched the caste names that were present in the current data, I did not add up all of the castes in a given classification (say backward castes) from the census. In other words, we compared the total number of Yadavs in the current data, in a given district, to the total number of Yadavs in the census data in the same district. The numbers reported in the tables below for backward castes comprise these Yadavs and all other backward castes represented in the current data.

[28]Often the names used in the current data do not correspond to those in the 1921 census. However, using caste ethnographies (such as, Singh 2002), it is possible to match up most of them.

is quite noisy for the upper caste group.

The earlier discussion of this section strongly suggests that village level caste composition is historically determined and the empirical analysis will treat the variation in caste composition across villages as exogenous.[29]

3. Data

The data used in this paper were collected by a team of researchers based at the World Bank and in India in 1997-1998.[30] The villages of study are located in south and southeastern Uttar Pradesh and north and central Bihar. Uttar Pradesh and Bihar, together with Madhya Pradesh, have been referred to as India's "poverty belt". All three states are characterized by unusually large populations with per-capita expenditure levels far below the poverty line. Eastern and southern Uttar Pradesh, from where the study villages were drawn, is generally poorer than the western part of the state, and poverty levels have been rising in recent years. Bihar, which lies just east of Uttar Pradesh, has the lowest per capita rural income in India, and is the most rural state in the country. It has suffered from unrest, inter-caste conflict, and political violence in recent times. Overall poverty levels are even higher in Bihar than in Uttar Pradesh, and highest in the Northern region.

The field survey was administered in villages drawn at random from 12 districts in Uttar Pradesh and 13 districts in Bihar. A total of 120 villages, with an overall sample size of 2250 households, were sampled; 57 villages in Bihar and 63 in Uttar Pradesh. All of the study villages are rural. Although small, mostly household-based industries such as wood gathering, bidi making, rope making and liquor brewing exist, the economies in these areas are primarily dependent on agriculture.

Information on the village caste composition is listed in Table 4. The most populous caste is either a BAC or SC. Between the two states, the upper castes are more prominent in Bihar, whereas the scheduled castes are more prominent in Uttar Pradesh. Land ownership is either in the hands of the upper castes or the BACs, the distribution across these two caste groups is slightly more equal in Uttar Pradesh. We will compare villages where upper castes own most of the land, to villages where the BACs own most of the land. We will not analyse Muslim dominated villages and

[29] An alternative strategy would have been to use the historical caste composition measures, listed in Table 3, as instruments for current day caste composition (this is the strategy followed by Banerjee and Somanathan 2004). This is not possible here as the caste variation is at the village level in the current data, whereas the caste variation in the historical data is at the district level. It is worth noting that almost all of the districts in the data comprise both high and low caste dominated villages. The empirical analysis will include district controls.

[30] The study team in India was headed by Ravi Srivastava (Allahabad University) who worked with other researchers from Allahabad University and local NGOs. The work was directed by Valerie Kozel at the World Bank.

also drop Muslim households from the analysis, which comprises only 2% of the sample in Hindu dominated villages.[31]

Household characteristics by caste group are listed in Table 5. The first four categories correspond to the primary source of livelihood for the household, which generally accounted for more than 50% of the household's total income. We see that the upper castes and BACs are primarily own farm cultivators. The lower castes, particularly the SCs, are more likely to be casual labourers. The OBCs are the most likely to be involved in petty business, whereas the upper castes are the most likely to be salaried employees. Literacy and schooling of the household head both increase with caste rank. Of those literate, 79% of the upper castes have achieved at least middle school, 57% for BACs, and approximately 45% for OBCs and SCs. For these two latter castes, approximately 22% of the literate have had no formal schooling. Though not listed in the table, the average age of household head does not vary greatly by caste, ranging between 45 and 50. All castes have, on average, 6 household members (the range, 5.5 to 6.3 members, is slightly increasing in caste rank).

Total annual income is the sum of wage income (for all household members), household enterprise income, total crop income, transfers into the household (typically from relatives), and the total value of home production of in-kind receipts of crops and food.[32] Total income also increases with caste rank. All castes generate the majority of their income from agricultural activities. Though not reported, income per capita also increases with caste. If we look at averages of enterprise income conditional on it being positive, then it too follows caste ranking and the same holds for household wage earnings. Upper castes accordingly have higher annual expenditures, particularly for non-food expenditures.[33] Upper castes also spend more on clothing, medical, and leisure activities, but most significantly on social expenses such as weddings and deaths. The amount of land owned (in acres) reported in Table 5 is conditional on owning land at all. The upper castes are the largest landholders in the overall sample, followed by the BACs. The variable "tenant" is a dummy variable equal to one if any of the household land is rented, sharecropped, or received as wage payment. The opposite holds for the variable "landlord". The total amount borrowed and the primary credit lender are reported conditional on borrowing. The current loan for all castes on average comprises significantly more than their annual income (3 to 5 times more). We see

[31]The category of scheduled castes (SC) also includes scheduled tribes, however, they are not widespread in the data. The areas where the majority of tribes reside formed independent states in late 2000: Jharkhand (formerly a part of Bihar) and Uttaranchal (formerly a part of Uttar Pradesh). This data set, collected in 1997-98, does not cover these districts.

[32]Income is measured in rupees, there are approximately 40 rupees to the U.S. dollar.

[33]The category of non-food expenditures in Table 5 comprises daily expenses such as gas, electricity, toiletries, transport, etc..

from Table 5 that caste relations play an important role in credit markets. Lower castes borrow primarily from upper castes, with the exception of BACs who are most likely to borrow from their own caste, as do the upper castes. Money lenders are also used by lower castes. Relatively few households use formal credit institutions.

3.1. Comparisons across village types

In this section we focus on the differences across the two types of villages, those where total land ownership is dominated by the upper castes (termed high caste villages in the tables that follow) and those where total land ownership is dominated by the BACs (termed low caste villages in the tables that follow).

3.1.1. Village Characterisitcs

We first focus on data from the village level questionnaire. We see from Table 6 that the total number of households does not significantly differ across the two types of villages. There are almost no upper castes residing in villages where the BACs dominate. Instead they themselves tend to be the most numerous caste, followed by the SCs. In the villages where land holdings are dominated by upper castes, either upper castes or SCs are the most numerous, though significant populations of the other castes are also typically present.

The variables reflecting village infrastructure reveal that upper caste dominated villages are somewhat more developed.[34] Likewise distance to facilities is lower in those villages. That being said, the differences across the two types of villages are not striking.

Variables which capture government and NGO programs targeted at the villages are in Table 6, which first lists information on government supported employment programs in the village during the past year. The second group of variables refers to government or NGO sponsored development programs. The number of employment programs and money allocated is higher in low caste villages. Approximately half of each type of village had an employment project aimed at building a road. The number of development projects did not differ across the two types of villages, neither did the type of project.

Agricultural characteristics across the villages are listed in Table 7. Land inequality, as represented by the Gini index, is higher in high caste dominated villages. This is to be expected given that the upper castes own significantly more land than the lower castes, as seen in Table 5.

[34]The single exception is the total number of handpumps, though relative to village population the average is slightly higher in high caste dominated villages.

Correspondingly, more total land is sharecropped in the high caste dominated villages. On average a greater proportion of cultivated land is irrigated in the lower caste villages. The main source of irrigation for all villages is private tubewells. There are not huge differences in soil quality across the two types of villages nor in cropping patterns and prices.[35]

Tables 6 and 7 do not reveal strong systematic differences at the village level across low and high caste dominated villages in terms of access to public goods or geographic determinants.[36] One key significant difference, however, is that a greater proportion of cultivated land is irrigated in the low caste dominated villages. This relationship is also confirmed if we look to the village level amenities data from the 2001 Census of India for the villages in our sample, which are summarized in the bottom part of Table 7. There we have information on access to public facilities such as schools, medical resources, electricity, credit, drinking water and irrigation sources. Again, we do not find any significant differences across the two types of villages. The only exception is that the total irrigated area and total irrigated area by private tubewells are both significantly higher in low caste dominated villages despite that access to other natural water sources are on average the same relative to the high caste dominated villages. These relationships suggest that the distribution of private irrigation water sytematically varies across the two types of villages.

3.1.2. Household Characteristics

In this section we focus on the differences across the two types of villages in terms of household characteristics by caste group. The data come from the household level questionnaire. The striking result from Table 8 is that BACs fair better, in terms of household income, if they reside in villages where their caste is dominant. This difference in income is mainly driven by agricultural income. In this respect, the BAC's in low caste villages are comparable, to the upper castes in high caste villages. This holds, despite the overall land ownership being smaller for the BAC's relative to both their own caste and the upper castes in the high caste villages. These BACs are also more likely to be literate in the low caste villages. Credit relations again primarily depend on caste. BACs are more likely to borrow from the dominant land holding caste, i.e., their own caste in low caste villages and upper castes in high caste villages.

We see from Table 9, that other lower castes (OBC and SC) also fair better in the low caste dominated villages. Again this difference is driven primarily by agricultural income. This is partic-

[35]Data on prevailing wages in the villages comprised too many missing variables to be useful. The exception was male skilled work, which also does not vary significantly across the two types of villages.

[36]The only exception is a larger number of government employment programs in low caste dominated villages. We will see that this variable does not however play a significant role in the estimations.

ularly the case for the SC group, who also own more land in the low caste villages and have higher literacy rates. The primary credit source for both caste groups is higher castes, but money lenders are used more in the low caste villages.

It should be noted that all results pertaining to household income in the above tables also hold for per capita income. More detailed information on the distributions of land ownership and agricultural income is listed in Table 10. Although the number of large landholders of BACs is larger in high caste villages, at each percentile in the agricultural income distribution, their incomes are higher in low caste dominated villages. BACs do not own more land in low caste dominated villages but they do own higher quality land, as represented by the value of their land.[37] The same relationship for crop income holds for the other lower castes, as listed in Table 11, though the effects are stronger for SCs.

These tables beg the question as to why agricultural income, by caste, is higher in low caste dominated villages. We now turn to characteristics of only cultivator households which form 75% of our total sample. The group of non-cultivators are essentially the landless households.[38] The aim is to characterise in more detail the agricultural inputs and outputs of cultivators.

Crop yields are measured as the value of produce sales from each crop per acre of land cultivated under that crop. These yields therefore exclude crops used for household consumption. The majority of households grow paddy (72%) and wheat (91%). Cereal and pulse crops are also common (42% and 55% of households respectively), whereas approximately 30% of households grow bulb and seed crops, and 20% have cash crops. Lower castes are more likely to grow paddy, bulb and cash crops in low caste dominated villages. We see from Table 12 that crop yields are higher for BACs residing in low caste villages for almost all crops (the exception is pulses). The difference in cash crop yields is particularly striking, the main cash crop grown is sugarcane. The yields reported in Table 12 are not conditional on being positive but the same relationships follow if instead they were. Crop intensity measures the total acres cultivated (which includes crops for home consumption) divided by the total amount of land the household has access to (including land owned, rented, share-cropped, etc.). Crop income per acre is equal to the total value of sales of all crops over the past year divided by the total land. Both of these measures are higher for

[37]The value of land is the response to the question of how much would it cost per acre to buy this type of land. Although, actual land sales are few in the area, taxes from land revenue are the most common form of tax for the local governments. Therefore, estimates of the value of land are likely known and this information can be gathered from the *Talathi* or *Gram Sevak* (government officials appointed to the villages).

[38]Of the non-cultivators, 90% are landless and 6% own not more than 1 acre of land. The remaining larger land holders who do not cultivate typically operate as landlords who either rent or share-crop thier land.

BACs if they reside in low caste dominated villages. In accord with the higher yields, inputs such as fertilizer and family labour into agricultural production are also higher for BACs residing in low caste villages. The proportion of land irrigated is also somewhat higher and households are more likely to use private tubewell irrigation as their primary source.[39] The proportion of households who own a private tubewell and pump does not substantially differ by caste nor across the two types of villages for BACs. BACs are more likely to be groundwater buyers in low caste dominated villages and sellers in high caste dominated villages. The last five variables list the proportion of households who own at least one of the farm implements listed. We see that there are not strong differences across castes groups or villages for BACs. The final category is the number of buffalo owned. Other livestock ownership variables are not reported as they are unlikely to be inputs into crop production.[40]

From Table 13, we see that a similar relationship between higher yields in low caste dominated villages also holds for the other lower castes residing in these villages. Cropping intensity is also higher for SCs in low caste dominated villages. SCs are more likely to depend on canal irrigation than other castes in low caste villages, though also more likely to own a tubewell and pump and sell water in the private groundwater markets.[41] SCs also own more farming implements in low caste dominated villages.

In summary, lower castes have significantly higher agricultural yields and crop more intensively if they reside in low caste dominated villages. This is particularly true for crops which are highly reliant on irrigation such as sugarcane and paddy. Consistent with this, these households are more likely to rely on tubewell irrigation and purchase water from the private groundwater market.

4. Estimations

We now turn to estimations of crop income aiming to understand why it is higher for lower castes in low caste dominated villages. The main sample for the analysis includes the lower caste groups who reside in both types of villages (BACs, OBCs, and SCs). However, the tobit estimations of Table 14 confirms the robustness of the relationship when the sample includes all caste groups.

[39] This is relative to canal irrigation, as listed in Table 12, and other natural sources not reported in the table.

[40] Also no other livestock variables proved significant in the estimations.

[41] As we see from Tables 12 and 13, private tubewells are the primary source of irrigation in this area. For all castes, the boring and pump set were primary financed by their own resources, approximately 64%. For about 20%, the purchase of a private irrigations system was funded by a government program (Agricultural Department, Minor Irrigation Department, Million Wells Scheme), the remaining 15% relied on loans. The use of loans over own resources increases as we move down the caste hierarchy. Also, lower castes are less likely to use their own resources in high caste villages relative to low caste villages.

That is, controlling for agricultural inputs, household characteristics, and village characteristics, there remains a significant and positive relationship between crop income and residing in low caste dominated villages. The estimation in the first column does not include any additional controls. The estimation in the second column includes crop and state controls. The third estimation includes the same controls with regression disturbance terms clustered at the village level. The final estimation includes crop and district controls. The most important result from Table 14 is that residing in a low caste village has a positive and significant effect on crop income per acre of total land in all three of the estimations. This result is robust to alternative ordinary least squares estimations for the entire sample and also for only those households who received positive revenue for their crops, with Huber robust standard errors and regression disturbance terms clustered at the village level. The results are also robust to estimations where the sample comprises only those who do not share-crop land or only those who do. The same results also persist if the dependent variable is instead yields per acre of cultivated land. Other significant positive determinants of agricultural yields include amount and value of land. When quadratic terms for total land and value of land are included, they enter negatively and significantly. Literate farmers, as well as share-croppers, have higher yields. Other important inputs include fertilizer and irrigation.[42] Private tubewell and pump ownership are also positive determinants of crop income.

The results from estimations analogous to Table 14 including only the lower caste group (BAC, OBC, SC) who reside in both types of villages are listed in Table 15. The most important result from this table is that residing in a low caste village has a positive and significant effect on crop income per acre of total land in all four of the estimations. The only other consistent relationships are positive ones between crop income and value of the land, fertilizer use, and share-cropping.[43] Other relationships are sensitive to the inclusion of different controls. The empirical specification used is only one of many that were estimated. Numerous additional household level variables were included such as farming implements and those which captured credit relations and borrowing histories. None of these additional controls were ever significant and the key positive relationship agricultural income and residing in a village dominated by a lower caste remained robust. Table 16 includes also village level information. The estimation results listed again represent only one empirical specification. We ran numerous estimations including almost all of the village level information at hand but most of these variables proved insignificant. More importantly, the positive

[42]Other inputs such as farming implements proved insignificant and are not reported.

[43]It could be argued that value of land is endogenous to current annual crop yields, however, this relationship seems quite indirect.

relationship between residing in a low caste dominated village and agricultural income remained robust in all of these specifications.

Table 17 reports estimation results where the key variable of low caste village is interacted with the other independent variables. Interestingly, once we include interaction terms, the effect of residing in a low caste village no longer significantly affects crop income on its own. The positive effect seems strictly related to being a water buyer in the private groundwater markets. Relative to high caste dominated villages, the crop income of tenants (share-croppers) is lower in low caste dominated villages. The estimation results in Table 18, show, however, that it is the first relationship, i.e., via water buyers, which is the key to explaining the higher crop income in low caste dominated villages. The positive significant effect of residing in a low caste village drops out once we interact it with water market activities. This held true also if we only interacted it with water buyers. Table 19 demonstrates this key result holds for various caste groupings. The main results reported in Tables 17 to 19 were robust to including additional interaction terms with village characteristics, crop controls, and caste controls.

The main finding of this section is that the functioning of private groundwater seems to be the key to explaining why yields amongst lower castes are so much higher in low caste dominated villages. We now turn to further inquiry into water markets in the area.

5. Groundwater Markets

The study area is located in what is known as the Ganga basin. This region has enormous groundwater potential and informal groundwater markets have emerged as an extremely important institution over the last three decades.[44] The use of groundwater in historical times was relatively uncommon in this region, there was normally adequate rainfall for crops in the *kharif* (wet) season (Prasad 1989). In the wake of a severe drought in eastern India in 1966-67, the advantages of groundwater irrigation over surface irrigation were poignantly realized. This boosted the development of groundwater irrigation and a perceptible expansion of private and public tubewells occurred after a later drought in 1972-73 (Prasad 1989, Pant 2004, Singh 1992). Although a number of public tubewells, which are invariably deep units (often greater than 80 meters), were installed in the region in the 1970s and early 1980s, most of them have become non-operational due to erratic and inadequate supply of electricity and a lack of repair and maintenance (Prasad 1989, Shah 1989, Meinzen-Dick

[44]See, Mukherji (2004) for a review of the literature. Selling groundwater has been prevalent for longer in other regions of India, even under traditional water extraction technologies. For example, Shah (1989) cites a study in Gujarat which documents well developed water markets for 70-80 years.

and Sullins 1994). As a result, groundwater utilization for agricultural purposes in this region is predominantly through private tubewells, which are typically shallow (generally less than 15 meters) and use diesel-operated pumps.[45] Shah (1989) estimates that more than 95% of the total area served by groundwater in India is irrigated by privately owned irrigation equipment.[46] Pant (2004) documents stupendous growth in private tubewells in Uttar Pradesh, where the estimated total was 3000 in 1951, 600 000 in 1977, and 1.05 million by 1980. Between 1986-87 and 1992-93, the density of tubewell and pump sets increased fourfold in Bihar (Kishore 2004). Some argue that the engine of growth in eastern India over this period was this accelerated diffusion of private shallow tubewells (Fujita and Hossain 1995, Mukherji 2004). The exploitation of groundwater through the use of tubewells converted fallow land of the dry season into fertile paddy fields well suited to the seed-fertilizer technology, available through the wave of the Green Revolution.[47] As a result, both cropping intensities and patterns vastly improved and yield rates witnessed a tremendous upward swing (Pant 2004, Singh 1992, Mukherji 2004, Roy and Shah 2002).

Most of the groundwater development which took place through private water extraction mechanisms was skewed in favour of larger farmers with a higher ability to invest (Singh and Singh 2003, Prasad 1989, Fafchamps and Pender 1997, Aggarwal 2005).[48] Nevertheless, the emergence of groundwater markets has been seen as an opportunity for more equitable access to groundwater irrigation for resource poor small and marginal farmers (Shankar 1992). In spite of the inequities in terms of pump and tubewell ownership, poorer farmers do tend to fair better with the development of private tubewells, where having access to groundwater at all has been a key to success (Shah 1989, 1991). Several studies show that cropping intensities and yields of tubewell owners and water buyers are comparable, reflecting that buyers are in fact receiving reliable and adequate irrigation water (Shah and Ballabh 1997, Kishore 2004). Shah (1989) cites studies which show that more than half of the total area irrigated by private irrigation systems, in many parts of India, belong to water purchasers.

This previous research highlights the very large returns to groundwater irrigation for water buyers. The main empirical finding here that lower caste water buyers have agricultural yields

[45]The pumps usually have a 5-8 horsepower capacity and have a pipe diameter of roughly 10 centimeters (Prasad 1989, Pant 2002). The tubewells cylinders are often indigenously constructed from bamboo, but can also be metallic or concrete (Wood 1999, Srinivas and Jalajakshi 2004).

[46]Many claim that groundwater is the backbone of irrigated agriculture in India (Roy and Shah 2002). Dains and Pawar (1987) estimate that 70-80 percent of the value of irrigated production in India may depend on groundwater irrigation. The World Bank and Ministry of Water Resources (1998) estimates that the contribution of groundwater to India's GDP is around 9%.

[47]During this time, the use of chemical fertilizer also increased over the traditional compost manure (Singh 1992).

[48]Almost all private tubewell ownership is individually owned (Mukherji 2004, Pant 2002, Aggarwal 2005).

which are 45% higher if they reside in a village dominated (in terms of landownership) by a lower caste compared to a higher caste suggests that buyers are getting better access to water in these former villages. Given that it is the larger landowners who own the irrigation pumps, a key difference between the two types of villages is that in the high caste dominated villages, the majority of water sellers are from the high caste, whereas in the low caste dominated villages, the water sellers are correspondingly of a lower caste.[49] The empirical results are therefore consistent with a scenario where lower caste water buyers obtain better access to groundwater when the majority of sellers are also of a lower caste, compared to when the majority of sellers are instead from a higher caste. We now turn to exploring why private groundwater trade may break down across the two caste groups.

5.1. Groundwater Contracts

Groundwater markets are characterised by barriers to entry which arise from the lumpiness of the tubewell investment coupled with credit constraints.[50] As a result, there has been significant concern over the potential power of local monopolies of groundwater, or "water-lords" (Shah 1993, Meinzen-Dick and Sullins 1994).[51] Since water transactions are restricted by topography and distance between source and field, market competition is likely to be little (Shah 1991).[52] The majority of tubewell and pump owners reported to be water sellers; generally sell their surplus water after meeting the needs of their own fields.[53] A given tubewell owner typically accommodates a small number of buyers within close physical proximity.[54] Due to conveyance costs involved in irrigating fields that are far, there is only a limited area surrounding the tubewell that can economically be irrigated by a given tubewell, and often water buyers are restricted to the choice of a single

[49] In the high caste dominated villages, 59.5% of the pump owners are from the upper castes, in the BAC dominated villages, 69.9% of the pump owners are BAC.

[50] In a study of West Bengal, Rawal (2002) estimates the costs of tubewells with diesel pumps to amount to 8000 to 12 000 Rs.. Tubewell installation cost amount to roughly a year's income for the average rural households in Pakistan (Jacoby et. al. 2004).

[51] Jacoby et. al. (2004) provide a model of groundwater price determination with monopolistic tubewell owners.

[52] Since average pumping costs in India show remarkable uniformity, water price variation can often be inferred to reflect differences in monopoly power (Shah 1989).

[53] An exception is Gujurat where water markets are highly developed and some individuals invest primarly to sell water (Kolavalli and Chicoine 1989). Refer to Meinzen-Dick and Sullins (1994) for references to numerous anecdotal reports and a growing number of studies of private water sales in Uttar Pradesh, Haryana, Punjab, Bihar, West Bengal, Orissa, and Andhra Pradesh. See, also, Mukherji (2004).

[54] Using data from Gujarat, Aggarwal (2005) finds, for example, that each water seller had on average 6 to 7 potential customers and each buyer had access to on average 1 to 2 sellers. In a study from eastern Uttar Pradesh, Shankar (1992) finds that tubewell owners sold water to on average 8 to 9 buyers.

seller.[55] Water is generally transported to the buyer's field either through unlined or lined field channels.[56] Matters of water conveyance, clearing the channel, and closing in between outlets are the responsibility of the water buyer. The main responsibility of the tubewell owner is to switch on and off the water pump. Bilateral oral contracts typically dictate the terms of exchange of groundwater transactions between buyers and sellers.[57]

In addition to driving up the price, monopoly power can affect quality of service with regards to adequacy and reliability of supply provided by sellers, where buyers have little recourse. Tubewell owners often follow a schedule of rotation for irrigating the fields of all of the buyers.[58]. Despite this institutionalized system, sellers are often reported to discriminate between buyers, particularly in times of irrigation shortages. There are reports of harassment of water buyers as sellers angle to extract more rents by threatening to reduce the water supply (Rawal 2002). To ensure repayment from water buyers, inter-linkages between water contracts and tenancy or credit contracts are common. Due to the moral hazard problems involved, exchange relationships are retained through village level institutions and norms (Dubash 2000). Studies report that the ability to pay the price does not guarantee access to groundwater, farmers must be networked (Wood 1999). In general, transactions are not impersonal, but are part of inter-linkages where sellers tend to give preference to relatives or members of their own caste, either through lower water rates or priority for service (Mukherji 2004, Meinzen-Dick and Sullins 1994, Ballabh et al. 2002, Dubash 2000, Wood 1999). According to Shah (1989), low prices relative to pumping costs generally imply a more balanced relationship of mutuality between buyers and sellers. Similarly, Pant (1991) observed, in Orissa, that the relative social and economic position of buyers and sellers can also affect water rates, where small farmers selling to large farmers charged less than large farmers selling to small farmers. Kajisa and Sakurai (2000), using a sample of villages in Madhya Pradesh, find that 62% of water transactions are conducted between buyers and sellers of the same caste, and of the 38% of transactions which are conducted between different caste groups, trade occurs between groups with the least social distance, as measured by caste rank. In a study from northeast Bihar, Wood (1999) similarly reports that traders operate strictly within their own caste, and in the case of

[55]Where landholdings are fragmented, most water sellers are also buyers because most farmers sink tubewells in one or two of their largest and best parcels and use purchased water for irrigating others (Shah 1989).

[56]Where water markets are most developed, underground pipeline networks may be used as in parts of Gujarat (Shah 1989). In areas where submerging tubewells is relatively inexpensive, instead a market for renting pumpsets can emerge (see, for example, Wood (1999), and further references in Mukherji 2004).

[57]Empirical research and anecdotal evidence indicate a variety of contract forms and a wide range of prices in groundwater markets. Dubash (2000), for example, finds that water pricing structures vary substantially across villages within close proximity, with similar cropping patterns, soil types, and hydrology.

[58]See, Rawal (2002). Dubash (2000), and Aggarwal (2005).

a numerically dominant landholding caste, trade is further restricted within particular extended lineages. Kozel and Parker (1999) report similar concerns prevailing between water seller and buyers throughout the present study area.

5.2. A Simple Model of Trade Breakdown

This evidence reported above suggests that caste ties or dominance may play a significant role in the enforcement of informal groundwater contracts within villages and that, in particular, trade is more common between members of the same caste. The aim of this section is to describe a very simple model which could explain why caste could matter to bilateral oral contracts between a buyer and seller of private groundwater.

In the context of private groundwater markets, the buyer and seller share some surplus from interaction where the monopolisitc seller can set the price. The environment is akin to the classical hold-up problem where agents undertake match specific investments prior to the exchange. In this case, buyers must incur the fixed costs of the water channels between thier field and that of the seller, denoted by β.

For simplicity, consider a production function that depends only on water, $f(w)$, where a fixed amount, one unit of the good, is required for positive agricultural yields. One unit of water is purchased at a price p which is set by the seller. The total value of the exchange to a buyer is represented by $f(1) - \beta - p$. If the buyer does not incur the investment then no trade occurs and the utility of the buyer is $f(0)$, which is assumed to equal 0. Assume for simplicity that the total value to the seller from the exchange is simply the price, p.

There exists a price $p > 0$ where the buyer will incur the fixed investment if:

$$f(1) - \beta - p \geq 0. \tag{5.1}$$

Given the seller has monopoly power, it will set the price prior to the exchange, denoted by p_0, so that (5.1) holds with equality and $p_0 = f(1) - \beta$.

The total surplus from reaching an agreement between the buyer and seller once the match specific investment, β, has been made is equal to $f(1)$, since the cost to the investment is already sunk. If contracts are not enforceable between the buyer and seller, then the seller will obtain all of the surplus to trade and request an ex post price, denoted by p_1, where $p_1 = f(1)$, which is greater than the ex ante price, $p_0 = f(1) - \beta$. At this ex post price, it is never worthwhile for the buyer to incur the match specific investment, since (5.1) does not hold when $p = p_1 = f(1)$.

Therefore, if a seller cannot credibly commit to the ex ante price $p = p_0$ then trade will not occur. The claim in this paper is that trade breaks down between high caste water sellers and low caste water buyers in high caste dominated villages, whereas in low caste dominated villages, trade occurs between low caste water sellers and buyers. There are several ways in which this hypothesis is consistent with the implications of this simple model in the context of the data. Generally the dominant caste in the village is responsible for resolving disputes between trading partners through their control over the village panchayats (governments) or councils (Rawal 2002). Moreover, the dominant caste typically favours members of its own caste (Srinivas 1987). In this sense, a seller of the dominant caste who deviates ex post from its commited price is more likely to be punished if the buyer is also from the dominant caste compared to when the buyer is from a lower ranked caste. In other words, there are no instruments for a lower caste buyer to punish a higher caste seller when the upper castes maintain the political power in the village.

Given the inherent social hierarchy of the caste system, it is not even necessary for the higher castes to dominate the village in order for this to be true. There are numerous historical and social reasons for why it would be very difficult for a lower caste member to punish someone from a higher caste. As a result, trade between high caste water sellers and low caste water buyers will break down because contracts are not enforceable, whereas trade between buyers and sellers of the same caste are more easily enforced.

5.3. Aggregate Water Market Activity

The idea that groundwater trade across caste groups could breakdown in villages where upper castes dominate is consistent with the empirical results of Section 4. There it was demonstrated that lower caste water buyers have better access to groundwater irrigation if they reside in villages where their own caste dominates and where the.majority of sellers are from their same caste. Further empirical evidence consistent with the claim that a trade breakdown across caste groups is an explanation for the high yields of water buyers in low caste dominated villages comes from looking at aggregated water market activity.

First suppose that caste status is irrelevant to groundwater trade arrangements. With this premise in mind, Table 20 attempts to capture the demand and supply in water markets at the village level. The total cultivated and owned land across two types of villages is computed using average land values, from the household level data, multiplied by the total number of households within each village, using the village level data. Similarly, the number of water buyers, sellers, and

pump owners relies on averages computed using the household level data of cultivators.[59] From Table 20, there is no evidence that the total amount of cultivated land is significantly different across the two types of villages. This also held true also if we looked at the total acres cultivated by crop. Nor are there significant differences between the total number of buyers, sellers and pump and tubewell owners. In other words, just looking at aggregate water market activity across the two types of villages does not explain why lower caste buyers are obtaining better access to groundwater irrigation in the low caste dominated villages. Given these village comparisions, there is no evidence that the price or supply of water is different across the two types of villages.

We now construct the same comparisons using only the lower castes (BAC, OBC, SC) in Table 21. These results, on the other hand, reveal significant differences. In the aggregate, it appears that the number of water sellers (and pump owners) is significantly higher in low caste dominated villages, whereas the number of buyers is significantly lower relative to the high caste dominated villages, if we only consider the lower castes. A plausible explanation arises if we suppose that upper castes do not trade water with lower castes. Then the aggregate information implies that water prices, faced by the lower castes, should be lower in the low caste villages. This could explain why low caste water buyers are able to gain better access to irrigation, and consequently produce significantly higher yields when residing in low caste dominated villages. The implications are that the presence of upper castes, who own a substantial proportion of the private tubewells and pumps, causes an inefficiency in the distribution of groundwater as they do not trade as easlily with lower castes in villages.

5.4. Alternative Factors

Our main empirical findings suggest that farm yields are systematically and substantially higher for low caste water buyers residing in villages dominated by water sellers of a lower caste compared to a higher caste. We conjecture that social identity is playing a key role where bilateral contracts are more easily enforced between members of the same caste. Our empirical support for this hypothesis is limited as we do not have data on the terms of trade of groundwater. There are indeed alternative explanations for a trade breakdown in groundwater which are not dependent on a measure of social distance. We do not, however, find support for these in the data.

[59] This aggregated data must be interpreted with caution as the total number of households per village in the household level data is only between 15 and 30.

5.4.1. Geographic distance between buyer and seller

One possibility is that caste identity is picking up the importance of geographic distance rather than social distance in trade relations. Indian villages are spatially divided into *hamlets* (neighbourhoods) which are often segregated by caste, where upper caste hamlets can be geographically distant from lower caste ones. Correspondingly, there can be systematic spatial variation by caste in the location of agricultural plots. As already emphasized, groundwater transaction costs are higher the greater the distance between the seller's tubewell and the buyer's field. Therefore, it is possible that trade in groundwater is breaking down across the caste groups, only because upper caste sellers are located further away from lower caste water buyers, relative to lower caste sellers. In other words, groundwater transaction costs are higher in the upper caste dominated villages. There are however, several findings in the data which go against this conjecture. The first is that if transaction costs are indeed higher, then we should expect that overall water market activity is lower in the high caste dominated villages. This goes against the findings of Table 20, where there are no significant aggregate differences in terms of number of water buyers and sellers per acre of land cultivated or owned.

Secondly, we can to some extent control for geographic distance between upper castes and lower castes in the estimations. There are a few variables which should be correlated with the geographic distance between the upper and lower caste groups. For one, the total area of the village should be positively correlated with the physical distance between castes. Two variables which reflect population density and should be negatively correlated with the caste geographic distance are the number of hamlets per hectare of the village and the proportion of hamlets which are mixed caste; that is, those in which upper and lower castes co-reside. However, as demonstrated in Table 6, there are no significant differences with regards to these distance measures across the two types of villages. Moreover, the main results are robust to the inclusion of these distance variables. The estimation results reported in Table 22 demonstrate that these distance variables do signifcantly affect agricultural incomes but do not explain the systematic difference across the two types of villages. We find that agricultural yields are higher in larger villages and when high and low caste groups are more likely to co-reside. However, these distance measures have no explanatory power when they are interacted with the dummy variable reflecting village caste dominance or the dummy variable for water buyer. We ran additional estimations on the agricultural income of just water buyers and also the probabilty of being a water buyer as a function of these distance measures and our other controls. Our key result that lower caste water buyers have higher agricultural incomes

if they reside in villages dominated by a lower caste remains robust (column 1, Table 23). Also the probability of being a water buyer is significantly higher in these low caste dominated villages controlling for these distance measures (column 2, Table 23). We do find that these transactions costs matter in trade. That is we find that the agricultural yields of water buyers in the low caste dominated villages are increasing in their probability of residing in the same neighbourhood as the dominant caste (column 4, Table 23). However, we find no significant effects for low caste water buyers residing in the high caste dominated villages (column 3, Table 23). That is, if trade is occurring, i.e., water buyers and sellers are both from the lower castes, then agricultural yields are indeed higher the lower are the transaction costs in water trade.

5.4.2. Groundwater quality

Groundwater accessibility and quality is highly dependent on the nature of aquifers and ambient climatic conditions. It is therefore possible that, for some reason, low caste dominated villages are naturally better endowed with groundwater resources. As already mentioned, villages in the data come from the Ganga Plain which contains one of the best reservoirs of groundwater in the world. The area has been formed out of thick alluvial deposits which can extend to a depth of 3000 meters below ground level and consist of porous and granular materials which are excellent water suppliers. It has a flat surface, fertile alluvial soil and favourable climate. Moreover, the majority of districts contained in this data (Eastern Uttar Pradesh and Northern Bihar) come from the best endowed hydrogeological areas with high-yielding aquifers.[60] Four major aquifers have been identified in the area covered in Uttar Pradesh and two to three in our region of interest in Bihar. Hydrogeological characterisitics of course transgress administrative boundaries and within a district there is topographic variation which determines groundwater potential. According to the Central Water Board, there is indeed district-wise variation in groundwater development and potential. The main estimations are robust to including such district-level information on average rainfall and evaporization rates, groundwater levels (pre and post monsoon), and the stage of groundwater development (refer to Table 24). It is important to recall that almost all of the districts in the sample contain both types of villages (dominated either by a high caste or low caste).[61]

At the village level we have information on natural water sources such as rivers, canals, lakes,

[60] One district in Bihar (Gaya) and two districts in Uttar Pradesh (Hamirpur and Banda) are located in the more southern geological regions with lower groundwater potential. The estimations are robust to including district-level fixed effects and also to leaving out these three districts.

[61] Four districts in the sample do not include villages which are dominated by the lower caste group. The estimations are robust to excluding those districts.

and ponds.[62] We also have information on village-level soil characteristics which are correlated with groundwater supplies such as the degree of alkalinity, salinity, flood proness, waterlogging, and erosion. There are, however, no significant differences with regards to these environmental measures across the two types of villages (see Table 7). Moreover, the main results are robust to the inclusion of these variables both when they enter in on their own and also when they are interacted with the dummy variable reflecting village caste dominance (refer to Table 24).

5.4.3. Land inequality

One salient feature of the data is that land inequality is higher in the high caste dominated villages. This follows because on average upper castes own larger plots than other castes. The efficient distribution of water tubewells given landholdings should not be affected by by who owns which plot. Therefore, it should not the case that the distance between the fields of buyers and the tubewells of sellers increases with the total plot size of sellers. However, it is likely the case that larger land holders have greater monopoly power. In this sense, water buyers could be worse off in high caste dominated villages just because there are a larger number of monopolists, irrespective of caste status. However, this claim is not consitent with the findings of Table 20 which demonstrate that the total number of sellers and buyers per acre of cultivated land are not significantly different across the two types of villages. Moreover, the significant correlation between agricultural yields and residing in a low caste dominated village is robust to including a gini index of land inequality. This held true also, if we include interaction terms.

Suppose alternatively that upper castes curtail the supply of water simply because they have larger landholdings and perhaps deeper tubewells.[63] Then we might expect to see a higher price of water just because of the presence of wealthier households with larger landholdings, not because they are upper caste per se. The problem with this explanation is that the cultivation intensity of the upper castes is lower than that of the BACs and therefore, proportionally, they should have more water available to sell.[64] It should only be in their interest to sell off their excess supply of water. It would seem that caste as a measure of social distance from potential buyers can better explain why they may not sell.

[62] This data come from the village level data from the 2001 Census of India.

[63] Foster and Rosenzweig (2005) analyse the relationship between tubewell depth, agricultural productivity, and land distribution.

[64] See Table 12.

6. Alternative Explanations

The main empirical finding of this paper is that income is systematically and substantially higher for low caste households residing in villages dominated by lower castes compared to higher castes. Our favoured interpretation is that agricultural yields are crucially determined by access to groundwater irrigation which is distributed through private markets. These markets seem to work more efficiently in villages where the caste composition is more homogeneous. We conjecture that bilateral contracts which are more easily enforced between members of the same caste explain why trade could break down across caste groups. As disussed above, our empirical support for this hypothesis is limited as we do not have detailed information on groundwater markets, however we are able to rule out several alternative factors which could explain a breakdown in groundwater trade. There are also a number of alternative explanations for our central empirical findings which have nothing to do with groundwater markets. However, in what follows we do not find support for these in our data either.

6.1. Land quality

A main claim of this paper is that caste is directly affecting economic outcomes. However, there are several plausible explanations for why agricultural yields may be higher in villages dominated by the lower castes which have nothing to do with caste (or inter-caste relations) per se. For one, yields may be higher in low caste dominated villages simply because lower caste households residing in these villages have higher quality land compared to their low caste counter-parts residing in the high caste dominated villages. In the empirical analysis, the main results are robust to including controls which capture the quality of land (measured by the value of land). Moreover, it is pump owners who have the highest quality land, therefore we should expect to see their yields significantly higher. Instead what we observe is that it is water buyers who are strictly better off.

It is possible though that this alternative hypothesis does indeed play a central role but is not entering into the estimations significantly on its own but instead is somehow complementary to the groundwater market results. For example, perhaps higher land quality is driving the results and estimations pick up its importance via groundwater markets only because the demand for irrigation is complementary to the quality of land. Although, if there is indeed complementarity between irrigation and land quality, we would again expect that the significant determinant of crop yields in low caste dominated villages should not be via water buyers but pump owners. The wealthier households have the higher quality land and can afford to incur the fixed costs of a

tubewell boring and hand pump. Nevertheless, we ran estimations which check for such interaction effects. These estimations, listed in Table 25, show that there does not seem to be a complementary relationship between access to groundwater and quality of land. This is particularly the case for water buyers, where the impact of quality of land on crop income is negative for them relative to others.

6.2. Tenancy and Credit Relations

There are other plausible explanations for why yields are higher in low caste dominated villages which related to caste but do not relate to groundwater markets. In particular, one might expect that tenancy relations are worse in high caste dominated villages; perhaps upper caste landlords treat low caste tenants poorly relative to a lower caste landlord. In the empirical analysis, the main results are robust to including controls which capture these components. That is, the estimations include variables for tenancy relations (measured by dummy variables for landlords, tenants, and proportion of share-cropped land). The main estimation results are the same if the sample includes only share-croppers or only those who do not share-crop any land. It is again possible though that this alternative hypothesis plays a central role but is not entering into the estimations significantly on its own but instead is somehow complementary to the groundwater market results. For example, we might expect complementarity between water markets and tenancy relations where, as found by Jacoby et al. (2004) for Pakistan, tenants receive lower prices and better access to water relative to other water buyers. In this case, we would expect to the see the complementarity between water buyers and being a tenant driving the results. Results from estimations, similar to those from Section 4, with interactions terms between the tenant and landlord dummy variables and water market activity are reported in Table 25. We do not find a significant complementary relationship between being a water buyer and a tenant (or share-cropper).[65] Additional estimations were run with interaction terms representing credit relations, that is who the household borrowed from (money lender, bank, higher, same, or lower caste) and amount borrowed. Again, there were no significant complementary effects.[66]

The simple model of Section 5.2 points to the inability of sellers to credibly commit to a price to explain why trade can break down across caste groups. This constrasts with the previous literature on groundwater contracts which has emphasized the moral hazard on the buyers side and highlighted the importance of inter-linkages between tenancy and credit relations to solve

[65]The raw data also do not show any significant correlation between tenancy and being a water buyer.
[66]The raw data also do not reveal any noteworthy correlations between being a water buyer and credit relations.

this enforcement problem.[67] It would seem that if it is moral hazard on the buyers' side which is more of a concern, and inter-linkages between tenancy and credit relations are not playing a central role here, then we would expect more trade across castes. That is, high caste landlords could potentially use their long-standing power to better enforce agreements with tenants who are of lower caste relative to a higher caste. This reasoning would suggest that because trade seems to break down across castes, it is the moral hazard on the sellers' side which may be the more important limit to water trade in the context of this data.

6.3. Political Power and Public Goods

A final possibility is a political economy explanation. The simple model of Section 5.2 emphasizes the role of caste-based political power in the enforcement of groundwater contracts to explain the main empirical findings. It is also possible that the political power of the dominant caste is having it's own direct affect on determining agricultural yields. The variation in caste dominance exploited here could be thought to imply ethnic heterogeneity: the villages where the upper castes are also present (the upper caste dominated villages) are more ethnically heterogeneous than those where only lower castes reside (the BAC dominated villages). A standard result is a negative correlation between ethnic diversity and economic outcomes, consistent with the findings here. It is commonly conjectured that more ethnically diverse communities have greater difficulty sharing public goods and resources, and are less able to impose social sanctions that prevent collective action failures. In the context of this data, lower caste households may fair better in low caste dominated villages because the political power is in their hands.[68] The data do not, however, provide any direct evidence for such an explanation in the sense that better access to community level resources played no significant role.

There are no strong systematic differences at the village level across low and high caste dominated villages in terms of access to public goods or resources. Nor is there any significant relationship between income for a given caste household and residing in a village where the same caste forms the most populous group, or where the village council leader is of the same caste, both of which would be correlated with greater political power in the village. Our key finding is that average household income, of all lower castes, is higher if residing in a village dominated by a low caste. That is, households tend to fair better in villages where there is less social distance between

[67]The exception is Aggarwal (2005) who conjectures that a risk averse water buyer would prefer a crop-sharing contract over a fixed payment contract to ensure reliable water delivery.

[68]Refer, for example, to the work of Pande (2003) who finds that political reservation for scheduled castes and tribes in Indian village councils has increased transfers to these social groups.

themselves and the dominant land owning caste. Table 26 verifies that this systematic relationship only relates to land owning dominance by caste and not instead population numbers or direct political power. In particular, there is no significant positive correlation between household income, for a given caste, and residing in a village where the most populous group is of the same caste, or where the village council leader (*Pradhan*) is of the same caste.[69]

The main estimation results of Section 4 are robust to including village level characteristics which would be correlated with better access to community level resources and direct political power. That is, the positive relationship between crop income and residing in a low caste dominated village remained robust. Residing in a village where the households' caste was the same as the most populous caste or of the Pradhan (village council leader) were not significant determinants of crop income and neither were measures of public resources such as electricity, drinking water and distance to facilities.[70] Additional estimations were run with interaction terms which included these variables and the key independent variable of low caste village dominance, and again the main result held.

7. Conclusion

The central empirical finding here is that yields are systematically higher for low caste households residing in villages dominated by lower castes (BACs), in terms of total land ownership, compared to villages dominated by upper castes. Our favoured interpretation is that agricultural yields are crucially determined by access to groundwater irrigation which is distributed through private markets. These markets seem to work more efficiently in villages where the caste composition is more homogeneous. We conjecture that bilateral contracts which are more easily enforced between members of the same caste explain why trade could break down across caste groups. This conjecture is in accord with anecdotal evidence in the area under study, where it is found that water transactions are strongly interpersonal. Individuals tend to conduct such trade with members of their own caste or close relatives. The presence of the upper castes, who own a substantial proportion of the

[69]Information on village pradhans was only available for the 63 villages located in Uttar Pradesh. In high caste dominated villages the caste of the Pradhan is upper caste for 38%, BAC for 35% and SC for 29%. For the low caste dominated villages, the Pradhan is BAC for 72%, and SC for 16%. The caste of the Pradhan is not a perfect measure of caste based political power since not all Pradhans in the sample have been democratically elected, due to reservation policies for scheduled castes and women in village councils (see, Pande 2003 and Duflo and Chattopadhyay 2004)

[70]The caste of the Pradhan may be endogenous to agricultural yields, where wealthier households are more likely to be of the same caste as the village leader. The gender of the Pradhan (following the strategy of Duflo and Chattopadhyay 2004) can be used as an exogenous source of variation which predicts the caste of the Pradhan. This IV estimation gives similar results.

private tubewells and pumps, therefore causes an inefficiency in the distribution of groundwater. This inefficiency is large and seems to be an example of social distance (the caste system) directly affecting the development of markets. Relative to more complex goods or services, these water trading relationships are still quite simple. They are bilateral agreements between two individuals who reside within close proximity and likely have done so for generations. That trade can break down under these circumstances is striking, particularly as the gains from trade are enormous for these very poor households.

References

[1] Aggarwal, R. (2005) "Role of risk sharing and transaction costs in contract choice: theory and evidence from groundwater contracts", *Journal of Economic Behavior and Organization*, forthcoming.

[2] Ahmad, I. and N.C. Saxena (1994) "Caste, Land and Political Power in Uttar Pradesh" in *Caste and Class in India*, K.L. Sharma (ed.) Rawat Publications, Jaipur.

[3] Akerlof, G. (1976) "The economics of caste and of the rat race and other woeful tales", *Quarterly Journal of Economics*, 90(4), 599-617.

[4] Alesina, A. and E. La Ferrara (2005) "Ethnic Diversity and Economic Performance", *Journal of Economic Literature*, forthcoming.

[5] Ballabh, V., S. Choudhary, S. Pandey, and S. Mishra (2002) "Groundwater development and agricultural production: a comparative study of eastern Uttar Pradesh, Bihar, and West Bengal" IWMI Working Paper, Gujarat.

[6] Banerjee, A., L. Iyer, and R. Somanathan (2005) "History, Social Divisions and Public Goods in Rural India" *Journal of the European Economic Association*, forthcoming.

[7] Banerjee, A. and R. Somanathan (2004) "The political economy of public goods: some evidence from India", *mimeo*, Department of Economics, MIT.

[8] Beteille, A. (1996) *Caste, Class and Power: Changing Patterns of Stratification in a Tanjore Village*. University of California Press, Berkeley.

[9] Dains, S. and J. Pawar (1987) "Economic returns to irrigation in India" US Agency for Internation Development Report, Delhi.

[10] Danda (1987) *A rural community in transition*. Inter-India Publications, Delhi.

[11] Dreze, J., P. Lanjouw, and N. Sharma (1999) "Economic Development in Palanpur, 1957-93" in *Economic Development in Palanpur over Five Decades*. P. Lanjouw and N. Stern (eds.), Clarendon Press, Oxford.

[12] Dubash, N. (2000) "Ecologically and socially embedded exchange: 'Gujarat Model' of water markets" *Economic and Political Weekly*, April 15, 1376-1385.

[13] Duflo, E. and R. Chattopadhyay (2004) "Women as policy makers: Evidence from a randomized policy experiment in India", *Econometrica*, 72(5), 1409-1443.

[14] Dumont, L (1970) *Homo Hierarchicus: The Caste System and its Implications*. University of Chicago Press, Chicago.

[15] Fafchamps, M. and B. Minten (2001) "Social Capital and Agricultural Trade", *American Journal of Agricultural Economics*, 83(3), 680-685.

[16] Fafchamps, M. and J. Pender (1997) "Precautionary savings, credit constraints and irreversible investment: Theory and evidence from semiarid India" *Journal of Business and Economic Statistics*, 15(2), 180-194.

[17] Foster, A. and M. Rosenzweig (2005) "Inequality and the sustainability of agricultural productivity growth: Groundwater and the Green Revolution in rural India", *mimeo*, Department of Economics, Brown University.

[18] Francois, P. (2002) *Social Capital and Economic Development.* Routledge, London.

[19] Fujita, K. and F. Hossain (1995) "Role of the groundwater market in agricultural development and income distribution: A case study in a northwest Bangladesh village", *The Developing Economies*, 33(4), 442-463.

[20] Greif, A. (1994) "Cultural beliefs and the organization of society: A historical and theoretical reflection on collectivist and individualist societies", *Journal of Political Economy*, 102(5), 912-950.

[21] Hoff, K. and P. Pandey (2004) "Why are social inequalities so durable? An experimental test of the effects of Indian caste on performance" Policy Research Working Paper no. 3351, The World Bank.

[22] Jacoby, H., R. Murgai, and S. Rehman (2004) "Monopoly power and distribution in fragmented markets: The case of groundwater", *Review of Economic Studies*, 71, 783-808.

[23] Jha, H. (1991) *Social Structures of Indian Villages: A Study of Rural Bihar.* Sage Publications, New Delhi.

[24] Kajisa, K. and T. Sakurai (2000) "Price determination under bilateral bargaining with multiple modes of contracts: A study of groundwater markets in India", FASID Working Paper, Japan.

[25] Kolavalli, S. and K. Chicoine (1989) "Groundwater markets in Gujarat, India" *Water Resources Development*, 5(1), 38-44.

[26] Kranton, R. (1996) "Reciprocal exchange: A self-sustaining system", *American Economic Review*, 86(4), 830-851.

[27] Kishore, A. (2004) "Understanding agrarian impasse in Bihar", *Economic and Political Weekly*, July 31, 3484-3491.

[28] Kozel, V. and B. Parker (1999) "Poverty in rural India: The contribution of qualitative reserach in poverty analysis", *mimeo*, The World Bank.

[29] Mandelbaum, D. (1970) *Society in India: Continuity and Change.* University of California Press, Berkeley.

[30] Marriott, M. (Ed.) (1955) *Village India.* University of Chicago Press, Chicago.

[31] Meinzen-Dick, R. and M. Sullins (1994) "Water markets in Pakistan: Participation and Productivity", IFPRI Discussion Paper.

[32] Mendelsohn, O. (1993) "The Transformation of Authority in Rural India". *Modern Asian Studies*, 27 (4), 805-842.

[33] Metcalf, T. (1967) "Landlord without Land: The U.P. Zamindars Today", *Pacific Affairs*, 40 (1/2), 5-18.

[34] Metcalf, T. (1979) *Land, Landlords, and the British Raj: Northern India in the Nineteenth Century*. University of California Press, Berkeley.

[35] Mukherji, A. (2004) "Groundwater markets in Ganga-Meghna-Brahmaputra Basin: Theory and Evidence", *Economic and Political Weekly*, July 31, 3514-3520.

[36] Munshi, K. and M. Rosenzweig (2005) "Why is mobility in India so low? Social insurance, inequality, and growth", BREAD Working Paper No. 097.

[37] Pande, R. (2003) "Can mandated political representation provide disadvantaged minorities policy influence? Theory and evidence from India", *American Economic Review*, 93(4), 1132-1151.

[38] Pant, N. (1991) "Development of groundwater markets in eastern Uttar Pradesh" *mimeo* Centre for Development Studies, Lucknow.

[39] Pant, N. (2002) "Groundwater issues in eastern and western alluvium of Ganga Basin" IWMI working paper, Gujarat.

[40] Pant, N. (2004) "Trends in groundwater irrigation in eastern and western UP", *Economic and Political Weekly*, July 31, 3463-3468.

[41] Platteau, J-P (2000) *Institutions, Social Norms, and Economic Development*. Harwood Academic Publishers, Amsterdam.

[42] Prasad, T. (1989) "Groundwater development for economic emancipation in the lower Ganges Basin: Problems, Prospects, and Strategies" in *Groundwater Irrigation and the Rural Poor: Options for development in the Gangetic Basin*. F. Kahnert and G. Levine (eds.), The World Bank, Washington, D.C..

[43] Rawal, V. (2002) "Non-market intervention in water-sharing: case studies from West Bengal, India", *Journal of Agrarian Change*, 2(4), 545-569.

[44] Roy, A. and T. Shah (2002) "Socio ecology of groundwater irrigation in India", IWMI Working Paper, Gujarat.

[45] Sahay, G. (2001) *Village Studies in India: A Case of Bihar*. Rawat Publications, Jaipur.

[46] Schwartzberg, J. (1965) "Caste Regions of the North Indian Plains" in *Structure and Change in Indian Society*, M. Singer and B. Cohn (eds.), Aldine Publishing Co., Chicago, 81-113.

[47] Shah, T. (1989) "Efficiency and equity impacts of groundwater markets: a review of issues, evidence, and policies" in *Groundwater Irrigation and the Rural Poor: Options for development in the Gangetic Basin*. F. Kahnert and G. Levine (eds.), The World Bank, Washington, D.C..

[48] Shah, T. (1991) "Water markets and irrigation development in India" *Indian Journal of Agricultural Economics*, 46(3), 335-348.

[49] Shah, T. (1993) *Water markets and irrigation development: Political economy and practical policy*. Oxford University Press, Bombay.

[50] Shah, T. and V. Ballabh (1997) "Water markets in north Bihar: Six village studies in Muzaffarpur District" *Economic and Political Weekly*, December 27, A-183-A-190. .

[51] Shankar, K. (1992) " Water markets in eastern U.P." *Economic and Political Weekly*, May 2, 931-933.

[52] Shanker, P. (1988) *Indian Village Society in Transition*. Commonwealth Publishers, Delhi.

[53] Shukla, N.K. (1976) *The Social Structure of an Indian Village*. Cosmo Publications, Delhi.

[54] Siddiqui, M. (1993) *Inter-Caste and Inter-Community Relationship: Developing Patterns*. Commonwealth Publishers, New Delhi.

[55] Singh, A.K. (2003) *Socio-economic status of farming communities in northern India*. New Royal Book Co., Lucknow.

[56] Singh, J. (1992) *Capitalism and dependence: agrarian politics in western Uttar Pradesh: 1951-1991*. Manohar Publishers, Delhi.

[57] Singh, K.S. (2002) *People of India*, Oxford University Press.

[58] Singh, D and R. Singh (2003) "Groundwater markets and the issues of equity and reliability to water access: a case of western Uttar Pradesh", *Indian Journal of Agricultural Economics*, 58(1), 115-127.

[59] Srinivas, M. N. (1976) *The Remembered Village*. University of California Press, Berkeley.

[60] Srinivas, M.N. (1955) "The Social System of a Mysore Village", in *Village India,* Marriott, M. (Ed.), University of Chicago Press, Chicago.

[61] Srinivas, M. N. (1987) *The Dominant Caste and Other Essays*. Oxford University Press, New Delhi.

[62] Srinivas, S.N. and C.K. Jalajakshi (2004) "Alternatives to micro-irrigation: Evaluation of the treadle pump" *Economic and Political Weekly*, September 18, 4271-4275.

[63] Tabellini, G. (2005) "Culture and institutions: Economic development in the regions of Europe", *mimeo*, IGIER, Bocconi University.

[64] Wood, G. (1999) "Private provision after public neglect: Bending irrigation markets in north Bihar" *Development and Change* 30, 775-794.

[65] World Bank (2004) *Public and private tubewell performance: emerging issues and options*. Washington D.C.

[66] World Bank and Government of India (1998) *India water resources management sector review: Groundwater regulation and management report*. World Bank and Government of India, Washington D.C. and Delhi.

[67] Yadava, J. (1971) "History and Development of a Village Settlement in North India", *Ethnohistory*, 18(3), 239-244.

Table 1 - In-Migration by District [71]

Districts	1931 Census		1951 Census		1991 Census	
	Across Districts	Across States	Across Districts	Across States	Across Districts	Across States
Bhagalpur	0.03	0.002	0.03	0.003	0.07	0.002
Champaran	0.02	0.01	0.01	0.01	0.03	0.01
Darhbhanga	0.02	0.001	0.02	0.001	0.06	0.002
Gaya	0.02	0.002	0.02	0.003	0.06	0.002
Mungher	0.03	0.003	0.03	0.001	0.06	0.003
Muzaffarpur	0.02	0.001	0.01	0.001	0.06	0.002
Purnea	0.07	0.02	0.05	0.01	0.06	0.01
Sahabad	0.02	0.02	0.02	0.01	0.04	0.01
Saran	0.01	0.01	0.01	0.01	0.05	0.01
Allahabad	0.04	0.01	0.06	0.02	0.04	0.01
Azamgarh	0.03	0.001	0.05	0.002	0.07	0.003
Bahraich	0.03	0.001	0.03	0.002	0.03	0.003
Banda	0.03	0.02	0.03	0.02	0.03	0.02
Basti	0.02	0.001	0.04	0.001	0.04	0.003
Faizabad	0.05	0.002	0.06	0.003	0.05	0.004
Ghazipur	0.04	0.02	0.05	0.01	0.04	0.01
Gorakhpur	0.01	0.005	0.04	0.006	0.04	0.02
Hamirpur	0.04	0.05	0.05	0.03	0.04	0.02
Jaunpur	0.05	0.001	0.06	0.002	0.05	0.003
Mirzapur	0.04	0.02	0.06	0.02	0.09	0.03

Table 2 - Bihar - Out-Migration[72]

Districts	1931 Census Moved Districts	1951 Census Moved Districts
Bhagalpur	0.05	0.06
Champaran	0.01	0.01
Darhbhanga	0.03	0.02
Gaya	0.04	0.05
Mungher	0.05	0.04
Muzaffarpur	0.03	0.03
Purnea	0.005	0.01
Sahabad	0.02	0.02
Saran	0.02	0.02

[71] Since the 1921 districts encompass the current-day districts, they are the ones listed in Table 1. The upper half of the table corresponds to the districts in Bihar, the lower half are those in Uttar Pradesh.

[72] Out-migrants do not include displaced persons to Pakistan.

Table 3 - Caste composition by district

	1997-98		1921 Census	
Districts	% Backward	% Upper	% Backward	% Upper
Bhagalpur	21.7	5.7	29.6	8.8
Champaran	35.9	1.0	27.1	4.3
Darhbhanga	20.8	9.3	26.9	13.2
Gaya	33.3	15.7	35.3	16.1
Mungher	33.8	6.8	27.8	8.7
Muzaffarpur	42.6	21.4	33.9	16.4
Purnea	22.5	2.2	8.7	1.5
Sahabad	26.6	36.3	16.9	24.7
Saran	19.8	20.3	24.0	23.3
Allahabad	33.8	5.2	28.3	13.2
Azamgarh	25.4	6.6	29.6	6.8
Bahraich	20.2	8.8	25.5	11.7
Banda	28.6	12.2	23.5	15.4
Basti	32.3	12.5	39.4	16.7
Faizabad	21.0	6.8	22.1	14.2
Ghazipur	30.0	0	28.1	N/A
Gorakhpur	39.6	1.2	40.0	9.6
Hamirpur	29.4	17.1	31.6	16.4
Jaunpur	20.0	10.2	26.3	15.1
Mirzapur	29.5	18.4	26.3	11.9

Table 4 - Village caste composition[73]

	All Villages	Bihar	Uttar Pradesh
Number of households	257	285	232
Most populous caste:			
Upper Caste	15 %	21 %	10 %
Backward Agricultural Caste (BAC)	34 %	33 %	35 %
Other Backward Caste (OBC)	13 %	12 %	14 %
Scheduled Caste (SC)	25 %	16 %	33 %
Muslim Upper Caste	8 %	11 %	5 %
Muslim Backward Caste	5 %	7 %	3 %
Caste with highest total amount of land owned:			
Upper Caste	40 %	39 %	41 %
Backward Agricultural Caste (BAC)	35 %	30 %	39 %
Other Backward Caste (OBC)	5 %	7 %	3 %
Scheduled Caste (SC)	3 %	2 %	3 %
Muslim Upper Caste	9 %	12 %	6 %
Muslim Backward Caste	8 %	10 %	6 %
Observations	120	57	63

[73]There is also a middle caste category in the data but only 2% of the sample fall into this category. Those who do are mainly from the Bania (Baniya) merchant caste, who would be more common in market towns. The upper caste group comprises mainly Brahmin and Rajput (Thakur) for both states and also Bhumihar in Bihar. The BAC group is predominantly made up of Yadav (Ahir), less prominent groups include Koiri, Kurmi, and Maurya. By comparison, the OBC category is very mixed, some of the more populous castes are Teli, Mallah, Kumhar, and Kahar. The SC group is mainly comprised of Chamars, less common castes include, Dusadh, Das (Pasi), Paswan, Mushar, and Dhobi.

Table 5 - Caste groups[74]

Variable	Upper	BAC	OBC	SC
Own farm	0.63 (0.48)	0.67 (0.50)	0.38 (0.48)	0.27 (0.45)
Casual labour	0.03 (0.18)	0.15 (0.36)	0.28 (0.45)	0.48 (0.50)
Salaried	0.18 (0.39)	0.09 (0.29)	0.09 (0.28)	0.07 (0.25)
Petty business	0.08 (0.27)	0.07 (0.26)	0.22 (0.41)	0.12 (0.32)
Literate	0.88 (0.33)	0.49 (0.50)	0.48 (0.50)	0.30 (0.46)
Total income	13505.0 (24815.1)	9228.0 (17316.2)	3918.4 (5664.9)	2915.9 (6726.1)
Wage income	1299.8 (2436.7)	712.5 (1350.7)	752.4 (1393.4)	694.1 (1167.6)
Farm income	9844.4 (23732.0)	6658.8 (15842.8)	1695.3 (5195.6)	1193.2 (6089.7)
Enterprise income	949.2 (2590.5)	667.1 (2651.2)	746.4 (1230.2)	395.5 (1300.1)
Transfers	145.5 (521.8)	65.7 (303.5)	41.2 (211.4)	26.1 (155.6)
Home production	1266.1 (1101.1)	1123.9 (837.1)	683.1 (594.4)	606.9 (521.5)
Food expenditure	1101.6 (779.9)	827.4 (573.9)	1000.4 (659.6)	857.1 (512.4)
Non-food expenditure	1483.1 (1997.5)	780.2 (1167.6)	586.7 (826.5)	411.2 (438.5)
Remittances	557.1 (2132.7)	168.1 (1263.3)	75.4 (605.3)	47.5 (285.7)
Social expenditures	4201.3 (17060.1)	1712.4 (8282.7)	1294.8 (6223.9)	619.4 (2678.9)
Landless	0.04 (0.21)	0.10 (0.30)	0.28 (0.45)	0.41 (0.49)
Land owned	5.2 (6.8)	3.5 (5.9)	1.6 (2.0)	1.6 (2.6)
Tenant	0.16 (0.36)	0.28 (0.45)	0.21 (0.41)	0.21 (0.41)
Landlord	0.20 (0.40)	0.07 (0.26)	0.07 (0.26)	0.05 (0.22)
Borrow	0.41 (0.49)	0.52 (0.50)	0.57 (0.50)	0.60 (0.49)
Amount owe	12045.5 (20160.7)	6318.1 (10530.6)	5344.1 (7429.3)	4642.5 (10012.3)
Borrow from employer	0.02 (0.15)	0.04 (0.21)	0.07 (0.26)	0.12 (0.33)
Borrow from money lender	0.12 (0.33)	0.21 (0.41)	0.17 (0.38)	0.20 (0.40)
Borrow from relative	0.19 (0.39)	0.19 (0.40)	0.17 (0.38)	0.11 (0.31)
Borrow from same caste	0.35 (0.48)	0.28 (0.45)	0.15 (0.36)	0.09 (0.29)
Borrow from higher caste	0.06 (0.25)	0.17 (0.37)	0.29 (0.46)	0.38 (0.49)
Borrow from lower caste	0.10 (0.30)	0.04 (0.19)	0.08 (0.27)	0.06 (0.23)
Borrow from bank	0.13 (0.34)	0.06 (0.23)	0.03 (0.18)	0.02 (0.13)
Observations	307	603	435	632

[74]We do not include the middle castes in this table as they account for only 2.5% of the total sample. Standard deviations are in parentheses.

Table 6 - Village Characteristics - Population, infrastructure and development programs

	High Caste Village	Low Caste Village
Number of households	245	278
Area (hectares)	275.7 (75.6)	274.6 (41.2)
Total Hamlets	3.0 (0.38)	3.5 (0.34)
Hamlets/Area	0.07 (0.05)	0.02 (0.003)
Mixed-caste hamlets	1.33 (0.18)	1.19 (0.16)
Most populous caste:		
Upper	37.5 %	0 %
Backward Agricultural	20.8 %	69.0 %
Other Backward	10.4 %	11.9 %
Scheduled	29.2 %	16.7 %
Infrastructure:		
Main drinking source - hand pump	44.7 %	35.7 %
Main drinking source - well	55.3 %	64.3 %
Number of handpumps	10.9	12.9
Not accessible by road	6.4 %	19.0 %
No waste disposal system	72.3 %	88.1 %
Electrified	61.7 %	52.4 %
Distance to facilities (km):		
Bus stop	3.6 (3.9)	3.9 (2.9)
Telephone service	5.4 (6.2)	7.9 (8.5)
Police station	7.7 (4.6)	8.2 (5.3)
Bank	5.1 (4.5)	5.3 (5.0)
Primary school	0.5 (0.7)	0.7 (1.0)
Middle school	2.8 (2.3)	2.9 (2.5)
Secondary school	5.1 (4.1)	5.5 (4.5)
Hospital	20.7 (15.7)	20.7 (16.4)
Govt./NGO Programs:		
No. Government employment programs	1.1 (1.3)	1.4 (1.5)
Money allocated	46856.1 (79262.1)	82237.2 (129674.2)
Project to build road	0.44 (0.50)	0.52 (0.50)
Project to build drinking water system	0.27 (0.45)	0.19 (0.40)
Project to build housing	0.08 (0.28)	0.17 (0.38)
No. Government or NGO development programs	0.64 (1.2)	0.62 (1.0)
Education Program	0.15 (0.36)	0.17 (0.38)
Health program	0.02 (0.14)	0.02 (0.15)
Irrigation Program	0	0.05 (0.21)
Drinking Water Program	0.15 (0.36)	0.14 (0.35)
Observations	48	42

Table 7 - Village Characteristics - Land and irrigation[75]

Variable	High Caste Village	Low Caste Village
% landless households	21.8 (18.4)	21.9 (20.5)
Land inequality (Gini)	0.65 (0.12)	0.59 (0.12)
Price of irrigated land (per acre)	119213.5 (82923.5)	123366.7 (142281.5)
Price of non-irrigated land (per acre)	57140.4 (33888.8)	55581.1 (33895.2)
Percentage of land on crop share/rent	21.0 (20.5)	10.6 (10.2)
Sharecropping Contract	83 %	89 %
Fixed rent Contract	17 %	11 %
No cultivatable is irrigated	4.2 %	7.1 %
<25% of cultivatable is irrigated	18.7 %	0 %
25-50% of cultivatable is irrigated	12.5 %	19.0 %
50-75% of cultivatable is irrigated	37.5 %	35.7 %
75-100% of cultivatable is irrigated	27.1 %	38.1 %
>50% land irrigated by canal	16.7 %	14.3 %
>50% land irrigated by public tubewell	4.2 %	4.8 %
>50% land irrigated by private tubewell	58.3 %	57.1 %
>50% land irrigated by lakes, ponds	0 %	0 %
>50% land irrigated by river	6.2 %	2.4 %
>50% land irrigated by traditional well	0 %	0 %
Almost no land suffers from floods	45.8 %	40.5 %
Almost no land suffers from alkalinity	70.8 %	73.8 %
Almost no land suffers from waterlogging	47.9 %	57.1 %
Almost no land suffers from soil erosion	75.0 %	71.4 %
Main crop is paddy	62.5 %	61.9 %
Main crop is wheat	20.8 %	21.4 %
Price of paddy (Rs/100 kg)	323.4 (56.8)	344.2 (109.1)
Price of wheat (Rs/100 kg)	455.7 (70.6)	455.0 (71.5)
Total land irrigated by canal	35.3 (11.5)	54.1 (23.0)
Total land irrigated by well	6.6 (3.3)	6.5 (2.9)
Total land irrigated by tubewell	20.5 (4.4)	46.8 (9.9)
Total land irrigated by tank	17.8 (12.4)	3.1 (2.0)
Total land irrigated by river	11.0 (10.9)	5.2 (4.0)
Total land irrigated by lake	0.53 (0.53)	0.12 (0.12)
Total land irrigated	100.0 (19.5)	151.9 (23.6)
Total culturable waste	12.4 (5.4)	24.8 (5.9)
Groundwater development	44.8 (1.9)	40.4 (2.0)
Groundwater availability	92034 (4795.9)	99728 (6260.7)
Observations	48	42

[75]All data listed in the first half of the table come from the village questionnaire with the exception of the Gini coefficient for land distribution. This was computed using the household level data, so should be not be weighted too highly as the number of households, in the household level data, per village is only between 15 and 30. Irrigation information in the second half of the table comes from the Census of India 2001; the groundwater information comes from the Central Water Board of India.

Table 8 - Household characteristics - Upper and Backward Agricultural Castes[76]

Variable	Upper High Caste Village	BAC High Caste Village	BAC Low Caste Village
Own farm	0.62 (0.49)	0.71 (0.46)	0.69 (0.46)
Casual labour	0.04 (0.19)	0.11 (0.31)	0.15 (0.35)
Salaried	0.19 (0.39)	0.09 (0.29)	0.09 (0.28)
Petty business	0.08 (0.27)	0.08 (0.27)	0.06 (0.23)
Literate	0.88 (0.33)	0.36 (0.48)	0.54 (0.50)
Total income	13286.5 (25317.4)	7452.9 (10642.9)	10958.4 (20584.2)
Wage income	1288.1 (2362.6)	698.6 (1398.6)	751.0 (1421.6)
Farm income	9605.4 (24250.1)	4891.3 (9822.6)	8285.5 (18694.9)
Enterprise income	986.5 (2644.1)	554.0 (1126.3)	718.7 (3065.8)
Transfers	147.0 (544.1)	85.3 (361.6)	66.6 (303.0)
Home production	1259.6 (1119.6)	1223.5 (911.0	1136.5 (826.3)
Landless	0.05 (0.22)	0.08 (0.27)	0.10 (0.29)
Land owned	5.1 (6.7)	4.8 (5.9)	3.8 (4.9)
Land value	94676.0 (72236.6)	82119.1 (54854.5)	90617.2 (49034.9)
Tenant	0.16 (0.36)	0.32 (0.47)	0.28 (0.45)
Landlord	0.20 (0.40)	0.07 (0.26)	0.07 (0.25)
Borrow	0.40 (0.49)	0.48 (0.50)	0.54 (0.50)
Amount owe	11718.0 (18585.6)	6850.0 (11708.4)	6158.9 (10636.5)
From employer	0.02 (0.13)	0.08 (0.28)	0.03 (0.16)
From money lender	0.13 (0.33)	0.15 (0.35)	0.23 (0.42)
From relative	0.17 (0.38)	0.17 (0.38)	0.18 (0.39)
From same caste	0.37 (0.48)	0.16 (0.37)	0.33 (0.47)
From higher caste	0.07 (0.26)	0.32 (0.47)	0.10 (0.30)
From lower caste	0.09 (0.29)	0.06 (0.24)	0.04 (0.19)
From bank	0.10 (0.30)	0.05 (0.22)	0.08 (0.27)
Observations	274	170	345

[76]The amount of land owned reported is conditional on it being positive. Similarly, the amount borrowed and the primary credit lender is reported conditional on borrowing.

Table 9 - Household characteristics - Other Backward and Scheduled Castes

Variable	OBC High Caste Village	OBC Low Caste Village	SC High Caste Village	SC Low Caste Village
Own farm	0.40 (0.49)	0.30 (0.46)	0.22 (0.42)	0.27 (0.45)
Casual labour	0.26 (0.44)	0.30 (0.46)	0.53 (0.50)	0.48 (0.50)
Salaried	0.09 (0.28)	0.07 (0.25)	0.06 (0.23)	0.05 (0.22)
Petty business	0.21 (0.41)	0.27 (0.45)	0.11 (0.31)	0.15 (0.36)
Literate	0.46 (0.50)	0.46 (0.50)	0.24 (0.43)	0.36 (0.48)
Total income	3458.9 (3667.8)	4599.7 (6706.0)	2092.9 (2288.6)	3989.7 (10557.4)
Wage income	808.9 (1317.2)	844.8 (1791.1)	706.9 (1166.9)	614.7 (1114.5)
Farm income	1166.2 (3310.5)	2148.4 (6242.1)	391.2 (1348.7)	2301.1 (9893.9)
Enterprise income	733.9 (1214.4)	844.0 (1325.2)	357.6 (863.8)	428.9 (1326.1)
Transfers	65.2 (239.7)	33.1 (248.7)	24.5 (113.3)	33.8 (221.5)
Home production	684.7 (580.0)	729.4 (607.0)	612.6 (537.9)	602.2 (494.2)
Landless	0.31 (0.46)	0.28 (0.45)	0.44 (0.50)	0.44 (0.50)
Land owned	1.4 (1.9)	1.4 (1.6)	1.1 (1.4)	2.1 (3.2)
Tenant	0.28 (0.45)	0.19 (0.40)	0.24 (0.43)	0.18 (0.39)
Landlord	0.09 (0.29)	0.08 (0.28)	0.03 (0.18)	0.07 (0.25)
Borrow	0.56 (0.50)	0.60 (0.49)	0.62 (0.49)	0.59 (0.49)
Amount owe	5853.4 (8393.2)	5404.5 (7796.6)	3974.7 (5443.1)	4653.6 (14531.5)
From employer	0.04 (0.21)	0.09 (0.29)	0.12 (0.33)	0.13 (0.33)
From money lender	0.17 (0.38)	0.22 (0.42)	0.13 (0.34)	0.28 (0.45)
From relative	0.09 (0.29)	0.17 (0.38)	0.10 (0.30)	0.09 (0.29)
From same caste	0.17 (0.38)	0.14 (0.35)	0.08 (0.27)	0.09 (0.28)
From higher caste	0.44 (0.50)	0.22 (0.42)	0.50 (0.50)	0.35 (0.48)
From lower caste	0.04 (0.21)	0.10 (0.31)	0.05 (0.22)	0.03 (0.17)
From bank	0.02 (0.15)	0.03 (0.18)	0.01 (0.11)	0.02 (0.12)
Observations	159	144	263	216

Table 10- Land and crop income - Upper and Backward Agricultural Castes[77]

	Upper High Caste Village	BAC High Caste Village	BAC Low Caste Village
Total Land:			
0-2 Acres	0.28 (0.45)	0.35 (0.48)	0.38 (0.48)
2-5 Acres	0.39 (0.49)	0.38 (0.49)	0.36 (0.48)
>5 Acres	0.30 (0.46)	0.25 (0.44)	0.19 (0.39)
Land Value:			
25th percentile	46000	35000	51000
50th percentile	80000	78500	90000
75th percentile	120000	110000	120000
Crop Income:			
25th percentile	3000	1800	2200
50th percentile	7500	3950	6400
75th percentile	19600	9000	15400
Observations	251	154	306

Table 11- Land and income - Other Backward and Scheduled Castes

	OBC High Caste Vill.	OBC Low Caste Vill.	SC High Caste Vill.	SC Low Caste Vill.
Total Land:				
0-2 Acres	0.68 (0.47)	0.73 (0.45)	0.75 (0.43)	0.57 (0.50)
2-5 Acres	0.23 (0.42)	0.14 (0.35)	0.18 (0.38)	0.26 (0.44)
>5 Acres	0.07 (0.25)	0.09 (0.29)	0.05 (0.21)	0.13 (0.34)
Land Value:				
25th percentile	56500	45000	25000	32500
50th percentile	100000	81000	60000	55750
75th percentile	120000	120000	100000	100000
Crop Income:				
25th percentile	1150	1200	800	1050
50th percentile	2200	2500	1580	3500
75th percentile	5000	6500	3100	10650
Observations	104	101	147	113

[77] Agricultural income is income generated from the selling of crops and excludes home production. Agricultural income and land values are reported conditional on being positive.

Table 12 - Agricultural inputs and outputs - Upper and Backward Agricultural Castes

Variable	Upper High Caste Village	BAC High Caste Village	BAC Low Caste Village
Total land	5.4 (6.9)	4.8 (5.9)	3.8 (4.9)
% land share-cropped	0.08 (0.19)	0.17 (0.28)	0.15 (0.27)
Total yields	1218.3 (2477.0)	642.5 (844.4)	1277.7 (1865.5)
Paddy yields	675.6 (1654.1)	374.7 (912.2)	707.4 (1861.0)
Wheat yields	784.3 (1597.0)	487.1 (987.6)	648.2 (1341.9)
Cereal yields	356.3 (1257.9)	151.0 (454.0)	283.6 (1460.6)
Pulse yields	1025.5 (2265.7)	1296.6 (3304.3)	848.4 (2561.4)
Bulb yields	915.7 (3003.2)	23.3 (208.2)	1001.1 (3029.6)
Seed yields	525.9 (2114.9)	375.3 (1580.2)	573.7 (3524.5)
Cash crop yields	1298.0 (4818.2)	458.5 (1704.5)	2233.6 (5250.1)
Crop intensity	2.1 (6.7)	2.0 (2.1)	2.5 (7.5)
Crop income/acre	1805.8 (3470.3)	1030.0 (1593.8)	2014.1 (3152.0)
% land irrigated	80.2 (27.6)	78.9 (29.4)	86.2 (23.7)
% irrigated all year	79.8 (32.8)	72.4 (38.8)	80.7 (34.0)
Tubewell irrigation	0.71 (0.46)	0.60 (0.49)	0.69 (0.46)
Canal irrigation	0.12 (0.33)	0.20 (0.40)	0.17 (0.38)
Own pump	0.31 (0.46)	0.27 (0.45)	0.30 (0.46)
Sell water	0.14 (0.35)	0.20 (0.40)	0.14 (0.35)
Buy water	0.69 (0.46)	0.58 (0.50)	0.75 (0.43)
Fertilizer/acre	561.6 (520.3)	503.4 (418.9)	735.6 (584.5)
Family labour/acre	476.1 (774.0)	642.0 (882.8)	846.1 (1272.0)
Tractor	0.05 (0.22)	0.03 (0.16)	0.04 (0.20)
Plough	0.33 (0.47)	0.49 (0.50)	0.54 (0.50)
Cart	0.07 (0.25)	0.12 (0.32)	0.09 (0.28)
Thresher	0.15 (0.36)	0.11 (0.31)	0.16 (0.37)
Cutter	0.51 (0.50)	0.53 (0.50)	0.52 (0.50)
Buffalo	0.47 (0.50)	0.76 (0.43)	0.66 (0.47)
Observations	251	154	306

Table 13 - Agricultural inputs and outputs - Other Backward and Scheduled Castes

Variable	OBC High Caste Vill.	OBC Low Caste Vill.	SC High Caste Vill.	SC Low Caste Vill.
Total land	1.9 (2.2)	2.1 (2.8)	1.5 (1.7)	2.8 (4.7)
% land share cropped	0.28 (0.39)	0.15 (0.28)	0.28 (0.39)	0.21 (0.33)
Total yields	393.9 (736.1)	919.2 (1678.7)	279.4 (698.2)	721.8 (1094.2)
Paddy yields	237.1 (713.8)	247.6 (713.6)	53.1 (325.7)	252.3 (681.0)
Wheat yields	202.7 (571.1)	470.8 (2561.1)	32.5 (238.4)	224.6 (664.5)
Cereal yields	101.7 (484.0)	21.5 (216.3)	49.5 (438.5)	70.8 (364.9)
Pulse yields	380.0 (1169.3)	463.3 (1404.1)	426.2 (1157.2)	1210.7 (2924.6)
Bulb yields	97.8 (452.5)	521.3 (1970.5)	56.7 (687.3)	235.2 (1352.4)
Seed yields	36.9 (231.4)	179.7 (765.9)	49.1 (317.7)	316.4 (1246.6)
Cash crop yields	848.6 (4563.8)	1018.6 (3025.9)	160.8 (1390.2)	490.1 (1993.4)
Crop intensity	2.7 (4.5)	1.8 (0.6)	2.7 (8.6)	3.1 (10.1)
Crop income/acre	853.6 (2349.3)	1299.5 (2012.0)	343.0 (774.0)	959.8 (1517.7)
% land irrigated	80.0 (33.0)	81.5 (32.6)	76.3 (38.3)	83.1 (29.3)
% irrigated all year	70.8 (38.9)	73.4 (39.6)	66.2 (43.8)	67.8 (44.4)
Tubewell irrigation	0.72 (0.45)	0.69 (0.46)	0.65 (0.48)	0.40 (0.49)
Canal irrigation	0.13 (0.34)	0.15 (0.36)	0.19 (0.39)	0.32 (0.47)
Own pump	0.08 (0.27)	0.13 (0.34)	0.02 (0.14)	0.15 (0.36)
Sell water	0.06 (0.23)	0.06 (0.24)	0.01 (0.12)	0.06 (0.24)
Buy water	0.76 (0.43)	0.74 (0.44)	0.70 (0.46)	0.73 (0.44)
Fertilizer/acre	726.4 (647.4)	874.6 (819.7)	620.6 (738.6)	569.3 (639.2)
Family labour/acre	813.3 (856.8)	1112.5 (1204.6)	752.1 (1317.9)	867.0 (1337.6)
Tractor	0	0.01 (0.10)	0	0.01 (0.09)
Plough	0.27 (0.45)	0.31 (0.46)	0.23 (0.42)	0.40 (0.49)
Cart	0.05 (0.21)	0.05 (0.22)	0.01 (0.12)	0.10 (0.30)
Thresher	0.06 (0.23)	0.05 (0.22)	0.01 (0.08)	0.04 (0.21)
Cutter	0.38 (0.49)	0.37 (0.48)	0.15 (0.36)	0.26 (0.44)
Buffalo	0.44 (0.50)	0.36 (0.48)	0.28 (0.45)	0.19 (0.40)
Observations	104	101	147	113

Table 14 - Tobit estimations of crop income/acre - All castes[78]

Variable	(1)	(2)	(3)	(4)
Literate	309.9 (237.3)	443.2 (237.1)*	443.2 (241.8)*	612.7 (233.8)***
Total land	174.7 (32.5)***	109.4 (26.7)***	109.4 (36.1)***	40.8 (18.0)**
Value of land	0.009 (0.002)***	0.008 (0.002)***	0.008 (0.003)**	0.009 (0.002)***
Fertilizer/acre	2.9 (0.6)***	2.3 (0.5)***	2.3 (0.4)***	0.9 (0.4)**
Labour/acre	0.06 (0.15)	0.12 (0.16)	0.12 (0.18)	0.21 (0.14)
Landlord	113.0 (357.2)	120.2 (325.4)	120.2 (335.2)	183.8 (299.6)
Tenant	405.6 (238.9)	454.7 (234.7)*	454.7 (249.5)*	390.6 (217.9)*
% land irrigated	6.8 (4.0)	5.1 (4.3)	5.1 (5.0)	10.7 (3.8)***
Own pump	1622.2 (433.5)***	1029.2 (407.9)**	1029.2 (346.3)***	690.9 (343.4)**
Sell water	694.2 (441.4)	236.7 (426.2)	236.7 (438.9)	600.6 (357.0)*
Buy water	855.6 (274.3)***	313.0 (278.0)	313.0 (358.3)	218.6 (249.5)
Tubewell	-607.0 (289.2)**	-622.5 (288.7)	-622.5 (543.0)	-67.9 (274.6)
Cutter	1072.6 (221.0)***	354.4 (208.1)*	354.4 (206.5)*	518.0 (196.9)***
Buffalo	741.7 (230.9)***	331.9 (226.4)	331.9 (306.6)	322.8 (206.3)
Low caste	-766.9 (343.0)**	-865.4 (349.1)**	-865.4 (593.3)	-647.8 (292.7)**
Low Caste Village	948.4 (237.0)***	847.7 (235.6)***	847.7 (424.6)**	701.9 (286.5)**
Constant	-4476.7 (450.4)***	-4286.4 (456.7)***	-4286.4 (664.4)***	-6852.6 (698.6)***
Observations	1623	1623	1623	1623
$\overline{R}^2$	0.03	0.04	0.04	0.06

[78] A single asterix denotes significance at the 10% level, double for 5%, and triple for 1%. Huber robust standard errors are in parentheses.

Table 15 - Tobit estimations of crop income/acre - Low castes[79]

Variable	(1)	(2)	(3)	(4)
Literate	77.1 (242.3)	209.8 (238.1)	209.8 (241.2)	377.9 (228.1)*
Total land	211.7 (44.7)***	124.8 (32.5)***	124.8 (44.2)***	34.5 (22.2)
Value of land	0.009 (0.003)***	0.006 (0.003)**	0.006 (0.003)*	0.01 (0.003)***
Fertilizer/acre	2.6 (0.4)***	2.3 (0.4)***	2.3 (0.4)***	1.3 (0.30)***
Labour/acre	0.12 (0.15)	0.14 (0.16)	0.14 (0.18)	0.19 (0.15)
Landlord	490.3 (422.5)	238.8 (378.8)	238.8 (340.0)	253.1 (383.7)
Tenant	444.3 (239.8)*	513.2 (251.1)**	513.2 (273.6)*	384.7 (233.8)*
% land irrigated	5.1 (4.2)	8.5 (4.8)*	8.5 (5.0)*	15.1 (4.3)***
Own pump	1254.2 (460.7)***	773.8 (435.8)*	773.8 (435.2)*	305.6 (381.3)
Sell water	1262.8 (521.5)**	688.2 (489.5)	688.2 (452.5)	900.7 (416.9)**
Buy water	821.5 (296.5)***	366.1 (312.0)	366.1 (396.5)	304.6 (276.0)
Tubewell	-463.5 (284.4)	-409.4 (275.1)	-409.4 (410.7)	46.7 (268.0)
Cutter	1159.8 (265.2)***	382.2 (263.6)	382.2 (270.8)	612.4 (259.3)**
Buffalo	464.9 (252.9)*	-128.6 (257.1)	-128.6 (354.2)	-140.4 (241.0)
Low Caste Village	1075.5 (234.4)***	883.2 (235.2)***	883.2 (388.2)**	679.3 (288.7)**
Constant	-4907.3 (470.2)***	-3912.8 (461.1)***	-3912.8 (621.5)***	-5610.9 (875.9)***
Observations	1295	1295	1295	1295
$\overline{R}^2$	0.04	0.05	0.05	0.07

[79]The sample is the lower castes (BAC, OBC, SC). The estimation in the first column does not include any additional controls. The estimation in the second column includes crop, caste, and state controls. The third estimation includes the same controls with regression disturbance terms clustered at the village level. The estimation in column four includes crop, caste, and district controls.

Table 16 - Tobit estimations of crop income/acre with village variables[80]

Variable	(1)	(2)	(3)	(4)
Literate	116.0 (250.0)	207.3 (242.6)	207.3 (243.2)	431.5 (232.4)*
Total land	167.0 (41.2)***	101.8 (30.4)***	101.8 (41.2)**	21.7 (21.3)
Value of land	0.02 (0.003)***	0.01 (0.003)***	0.01 (0.004)***	0.01 (0.003)***
Fertilizer/acre	2.7 (0.4)***	2.3 (0.4)***	2.3 (0.4)***	1.4 (0.3)***
Labour/acre	0.11 (0.15)	0.16 (0.15)	0.16 (0.16)	0.19 (0.15)*
Landlord	245.9 (422.8)	130.7 (385.5)	130.7 (356.5)	154.4 (390.3)
Tenant	370.7 (248.0)	501.0 (258.7)*	501.0 (286.8)	427.7 (244.9)
% land irrigated	2.1 (4.4)	6.9 (4.9)	6.9 (5.0)	16.6 (4.4)***
Own pump	1303.5 (469.0)***	947.2 (457.3)**	947.2 (494.1)*	280.1 (406.1)
Sell water	1068.1 (521.3)**	549.5 (492.2)	549.5 (439.5)	917.2 (438.5)**
Buy water	654.3 (299.7)**	445.6 (309.3)	445.6 (384.6)	589.1 (280.8)**
Tubewell	-171.1 (286.8)	-324.8 (282.8)	-324.8 (407.8)	26.0 (280.4)
Cutter	1077.9 (278.3)***	424.2 (274.9)	424.2 (270.5)	546.2 (258.6)**
Buffalo	557.7 (257.8)**	12.7 (262.3)	12.7 (365.1)	32.6 (249.0)
Low Caste Village	965.8 (244.0)***	1012.6 (248.6)***	1012.6 (420.0)***	992.4 (312.9)***
Gini (land distribution)	-2973.5 (1056.9)***	1122.2 (1187.9)	1122.2 (2163.2)	2875.3 (1399.4)**
Total Govt. Programs	45.3 (51.5)	-91.3 (66.3)	-91.3 (89.5)	-425.3 (90.8)***
Price of irrigated land	-0.004 (0.001)***	-0.004 (0.001)***	-0.004 (0.001)***	0.002 (0.001)
Price of non-irrigated land	-0.01 (0.004)***	-0.02 (0.004)***	-0.02 (0.007)**	-0.02 (0.006)***
Skilled male wage	-8.7 (8.2)	-7.5 (9.0)	-7.5 (16.1)	25.6 (9.4)***
Constant	-1704.9 (996.6)*	-2958.1 (995.6)***	-2958.1 (1757.9)	-9289.4 (1512.9)***
Observations	1295	1295	1295	1295
$\overline{R}^2$	0.04	0.06	0.06	0.08

[80]The sample is the lower castes (BAC, OBC, SC). The estimation in the first column does not include any additional controls. The estimation in the second column includes crop, caste, and state controls. The third estimation includes the same controls with regression disturbance terms clustered at the village level. The estimation in column four includes crop, caste, and district controls.

Table 17 - Tobit estimations of crop income/acre with interaction variables[81]

Variable	(1)	(2)	(3)	(4)
Literate	-268.0 (363.5)	-7.9 (353.5)	-7.9 (380.0)	361.5 (331.5)
Total land	205.8 (47.8)***	105.8 (39.3)***	105.8 (51.2)**	37.3 (33.7)
Value of land	0.005 (0.004)	0.003 (0.004)	0.003 (0.004)	0.005 (0.004)
Fertilizer/acre	1.5 (2.6)	2.6 (2.6)	2.6 (2.8)	-0.12 (2.3)
Labour/acre	0.001 (0.3)	0.03 (0.30)	0.03 (0.3)	0.14 (0.24)
Landlord	1206.9 (588.8)**	598.8 (525.4)	598.8 (489.8)	-8.2 (436.7)
Tenant	1103.3 (339.1)***	1209.3 (356.2)***	1209.3 (362.0)***	785.7 (353.1)**
% land irrigated	5.1 (6.6)	8.5 (6.5)	8.5 (6.1)	12.6 (6.2)**
Own pump	699.3 (659.1)	181.4 (684.2)	181.4 (684.8)	88.1 (602.6)
Sell water	1226.8 (870.1)	891.6 (857.6)	891.6 (915.0)	1284.2 (742.2)*
Buy water	-214.7 (430.8)	-420.2 (407.6)	-420.2 (498.1)	-227.7 (374.8)
Tubewell	167.3 (450.9)	126.8 (439.9)	126.8 (514.9)	790.6 (383.7)**
Cutter	1239.2 (361.6)***	625.5 (344.5)*	625.5 (353.5)*	590.1 (327.7)*
Buffalo	455.5 (365.9)	-233.0 (358.4)	-233.0 (425.0)	-449.6 (338.7)
Low Caste Village	-267.6 (494.0)	64.3 (501.0)	64.3 (757.0)	-610.7 (547.7)
Low Caste Vill*Literate	560.4 (491.1)	350.4 (501.0)	350.4 (525.5)	2.0 (463.9)
Low Caste Vill*Total land	2.4 (77.6)	31.5 (58.8)	31.5 (69.0)	-9.2 (43.4)
Low Caste Vill*Value of land	0.007 (0.006)	0.005 (0.006)	0.005 (0.006)	0.01 (0.005)*
Low Caste Vill*Fertilizer/acre	1.0 (2.6)	-0.46 (2.6)	-0.46 (2.8)	1.40 (2.4)
Low Caste Vill*Labour/acre	0.2 (0.4)	0.15 (0.36)	0.15 (0.37)	0.07 (0.30)
Low Caste Vill*Landlord	-1265.8 (833.8)	-579.5 (753.8)	-579.5 (745.7)	443.9 (700.4)
Low Caste Villa*Tenant	-1140.0 (491.5)**	-1184.5 (492.5)**	-1184.5 (592.2)*	-666.3 (462.6)
Low Caste Vill*% land irrig.	2.4 (8.8)	1.3 (8.5)	1.3 (8.3)	4.9 (8.2)
Low Caste Vill*Own pump	875.1 (892.1)	917.1 (900.4)	917.1 (849.1)	449.1 (773.8)
Low Caste Vill*Sell water	-102.1 (1060.4)	-311.3 (1048.9)	-311.3 (1038.2)	-747.5 (900.1)
Low Caste Vill*Buy water	1747.1 (599.6)***	1403.0 (551.2)***	1403.0 (679.5)**	1081.6 (490.5)**
Low Caste Vill*Tubewell	-875.5 (579.0)	-767.4 (567.6)	-767.4 (723.1)	-1206.4 (531.8)**
Low Caste Vill*Cutter	-199.0 (491.9)	-380.5 (481.8)	-380.5 (515.4)	-51.9 (472.8)
Low Caste Vill*Buffalo	28.5 (487.4)	147.1 (468.1)	147.1 (624.6)	579.6 (429.6)
Constant	-4262.8 (446.7)***	-3502.8 (499.0)***	-3502.8 (661.5)***	-4806.6 (873.2)***
Observations	1295	1295	1295	1295
$\overline{R}^2$	0.04	0.06	0.06	0.07

[81]The sample is the lower castes (BAC, OBC, SC). Similar to the previous tables, the estimation in the first column does not include any additional controls. The estimation in the second column includes crop, caste, and state controls. The third estimation includes the same controls with regression disturbance terms clustered at the village level. The estimation in column four includes crop, caste, and district controls.

Table 18 - Tobit estimations of crop income/acre with interaction variables[82]

Variable	(1)	(2)
Literate	220.2 (237.6)	180.2 (238.0)
Total land	127.0 (32.7)***	120.6 (31.8)***
Value of land	0.006 (0.003)**	0.007 (0.003)**
Fertilizer/acre	2.2 (0.4)***	2.2 (0.4)***
Labour/acre	0.13 (0.16)	0.15 (0.16)
Landlord	527.2 (535.5)	228.8 (379.3)
Tenant	1096.4 (363.6)***	498.2 (250.3)**
% land irrigated	9.2 (4.8)*	9.3 (4.7)**
Own pump	746.0 (432.9)*	217.0 (702.5)
Sell water	722.1 (485.6)	898.2 (866.8)
Buy water	382.4 (310.7)	-384.6 (363.4)
Tubewell	-368.9 (276.8)	-402.2 (273.8)
Cutter	419.8 (264.0)	336.4 (261.7)
Buffalo	-162.1 (256.1)	-106.7 (258.1)
Low Caste Village	1257.9 (315.2)***	-19.6 (366.3)
Low Caste Village*Landlord	-513.0 (751.4)	
Low Caste Village*Tenant	-1026.5 (494.2)**	
Low Caste Village*Own pump		939.1 (832.6)
Low Caste Village*Sell water		-405.7 (1062.3)
Low Caste Village*Buy water		1303.0 (451.0)***
Constant	-4127.6 (476.3)***	-3466.6 (480.5)***
Observations	1295	1295
$\overline{R}^2$	0.05	0.05

[82]The sample is the lower castes (BAC, OBC, SC). All estimations include caste, crop and state controls.

Table 19 - Tobit estimations of crop income/acre with interaction variable[83]

Variable	All Castes	BAC	SC
Literate	431.2 (234.0)*	329.8 (339.7)	249.1 (366.0)
Total land	107.0 (26.5)***	105.8 (31.9)***	98.0 (55.5)*
Value of land	0.008 (0.002)***	0.01 (0.004)***	-0.001 (0.005)
Fertilizer/acre	2.3 (0.5)***	2.6 (0.6)***	-0.8 (2.1)
Labour/acre	0.12 (0.16)	-0.07 (0.2)	0.32 (0.15)**
Landlord	110.0 (324.5)	-205.2 (456.3)	1583.3 (630.3)***
Tenant	441.2 (234.8)*	-44.2 (319.1)	1037.0 (445.7)**
% land irrigated	5.1 (4.3)	8.4 (6.5)	5.0 (5.2)
Own pump	1114.4 (413.3)***	960.3 (556.8)	1409.6 (787.9)*
Sell water	154.7 (424.7)	820.9 (573.8)	-2263.3 (1064.3)**
Buy water	-102.9 (332.9)	-468.8 (533.6)	-74.8 (573.0)
Tubewell	-626.7 (289.4)	-447.0 (345.3)	-406.7 (519.4)
Cutter	349.1 (207.4)	246.3 (338.9)	201.9 (557.9)
Buffalo	336.1 (226.9)	561.2 (370.6)	-354.0 (440.9)
Low Caste	-904.1 (352.0)***		
Low Caste Village	251.5 (344.6)	-304.7 (529.2)	346.7 (468.4)
Low Caste Village*Buy water	956.3 (476.4)**	1566.5 (690.5)**	1233.0 (614.3)**
Constant	-3995.2 (454.3)***	-2997.1 (734.4)***	-3731.8 (523.4)***
Observations	1623	513	479
$\overline{R}^2$	0.05	0.03	0.10

[83]The first estimation includes the entire sample of castes (Upper, BAC, OBC, SC). All estimations include crop and state controls.

Table 20 - Water markets at the village level - all castes[84]

	High Caste Villages	Low Caste Villages	Equivalence of Means
Acres cultivated	883.8 (825.7)	915.2 (803.2)	-31.3 (172.3)
Acres owned	468.6 (436.5)	436.4 (414.4)	32.2 (90.1)
Population	208.1 (127.2)	236.9 (140.1)	-28.7 (28.2)
Buyers per capita	0.70 (0.27)	0.75 (0.22)	-0.05 (0.05)
Buyers/land cultivated	0.21 (0.24)	0.21 (0.15)	-0.005 (0.04)
Buyers/land owned	0.62 (1.90)	0.45 (0.32)	0.17 (0.30)
Sellers per capita	0.10 (0.11)	0.11 (0.11)	-0.02 (0.02)
Sellers/land cultivated	0.02 (0.03)	0.03 (0.01)	-0.009 (0.007)
Sellers/land owned	0.05 (0.07)	0.06 (0.06)	-0.01 (0.01)
Pumps per capita	0.19 (0.13)	0.24 (0.17)	-0.05 (0.03)
Pumps/land cultivated	0.04 (0.03)	0.06 (0.06)	-0.016 (0.010)
Pumps/land owned	0.09 (0.08)	0.11 (0.08)	-0.027 (0.018)
Observations	48	42	

Table 21 - Water markets at the village level - lower castes

	High Caste Villages	Low Caste Villages	Equivalence of Means
Acres cultivated	433.4 (571.8)	886.0 (784.7)	-452.6 (143.5)***
Acres owned	172.3 (277.5)	415.8 (403.8)	-243.5 (72.3)***
Population	140.0 (92.9)	230.8 (136.6)	-90.7 (24.4)***
Buyers per capita	0.73 (0.31)	0.75 (0.23)	-0.02 (0.06)
Buyers/land cultivated	0.40 (0.53)	0.22 (0.15)	0.19 (0.08)**
Buyers/land owned	1.43 (2.31)	0.46 (0.32)	0.97 (0.36)***
Sellers per capita	0.06 (0.11)	0.11 (0.11)	-0.05 (0.02)**
Sellers/land cultivated	0.02 (0.03)	0.03 (0.04)	-0.014 (0.007)**
Sellers/land owned	0.04 (0.08)	0.06 (0.06)	-0.02 (0.01)
Pumps per capita	0.09 (0.13)	0.23 (0.17)	-0.14 (0.03)***
Pumps/land cultivated	0.02 (0.03)	0.06 (0.06)	-0.03 (0.01)***
Pumps/land owned	0.06 (0.09)	0.11 (0.09)	-0.05 (0.02)**
Observations	48	42	

[84]Standard deviations are in parentheses in first and second columns. Standard errors are in parentheses in the third column.

Table 22 - Tobit estimations of crop income/acre with distance measures[85]

Variable	(1)	(2)	(3)
Low Caste Village	850.6 (280.6)***	-850.8 (781.1)	267.7 (439.3)
Area	0.74 (0.28)***	0.58 (0.30)**	0.46 (0.31)
Hamlets per area	-801.3 (1081.3)	-903.6 (1092.5)	-9743.3 (13957.7)
Proportion mixed hamlets	1042.8 (365.4)***	735.0 (568.3)	890.2 (563.3)
Low Caste Village*Water Buyer		967.4 (541.6)*	916.4 (546.4)*
Low Caste Village*Area		1.11 (0.82)	
Low Caste Village*Hamlets/area		20453.1 (13148.6)	
Low Caste Village*Prop. Mixed Hamlets		844.9 (743.4)	
Water buyer*Area			0.96 (0.71)
Water buyer*Hamlets/Area			9337.0 (14022.3)
Water buyer*Prop. Mixed Hamlets			268.3 (709.8)
Observations	1127	1127	1127
$\overline{R}^2$	0.05	0.05	0.10

Table 23 - Estimations with distance measures for water buyers[86]

Variable	Crop Income	Probability Water Buyer	Crop Income High Caste Village	Crop Income Low Caste Village
Low Caste Village	813.4 (349.7)**	0.21 (0.11)*		
Area	0.82 (0.75)	-0.0004 (0.0002)*	2.52 (1.04)**	-0.05 (0.96)
Probability of residing near dominant caste	922.8 (635.3)	0.18 (0.17)	401.2 (656.0)	1695.3 (896.8)*
Observations	754	806	233	362
$\overline{R}^2$	0.03	0.15	0.05	0.03

[85]The estimations include all of the household controls in the earlier estimations (such as Table 14). We just report the results for the distance measures. The sample is the lower caste groups (BAC, OBC, SC).

[86]The estimations include all of the controls in the earlier estimations (such as Table 14). We just report the results for the distance measures. The variable representing the probability of residing near the dominant caste is computed using the proportion of hamlets where household's caste and the dominant caste of the village co-reside. The sample for all estimations is lower caste groups (BAC, OBC, SC). Tobit estimations on crop income per acre are only for water buyers. The second column is a probit estimation on the probablity of being a water buyer conditional on being a cultivator.

Table 24 - Tobit estimations of crop income/acre with groundwater variables[87]

Variable	(1)	(2)	(3)	(4)
Low Caste Village	786.8 (272.2)***	1927.8 (362.7)***	1132.4 (574.0)**	-2711.9 (2162.5)
Rainfall	1.2 (0.53)**	-1.01 (0.87)	9.3 (3.7)**	0.65 (0.86)
Groundwater Development	-35.7 (11.4)***	3.09 (17.1)	65.2 (38.7)*	-51.7 (15.1)***
Groundwater Availability	-0.006 (0.004)	0.0004 (0.005)	0.007 (0.009)	-0.01 (0.007)
Groundwater Depth (pre-Monsoon)			1259.6 (406.7)***	
Groundwater Depth (post-Monsoon)			-1502.4 (603.3)**	
Low Soil Erosion	-188.5 (323.0)	-189.4 (428.2)	-443.9 (712.4)	651.1 (484.3)
Low Alkalinity	-455.5 (282.8)	-60.0 (413.9)	-463.8 (474.8)	24.0 (437.6)
Low Waterlogging	-1138.8 (259.5)***	-1354.4 (360.6)***	-967.2 (517.5)*	-1370.5 (392.3)***
Low Flood Proneness	419.2 (273.4)	-110.2 (393.8)	1154.2 (519.9)**	118.1 (375.0)
River	-158.9 (530.2)	1575.9 (865.5)*	966.4 (735.7)	-684.0 (659.8)
Canal	898.6 (320.2)***	582.3 (467.5)	1908.6 (653.9)***	1494.9 (489.8)***
Low caste village*Water Buyer				1153.9 (487.4)**
Low caste village*Rainfall				1.26 (1.14)
Low caste village*Groundwater Dev.				37.5 (23.3)
Low caste Village*Groundwater Avail.				0.005 (0.008)
Low caste Village*Low Soil Erosion				-1187.0 (589.0)**
Low caste Village*Low Alkalinity				-469.4 (611.1)
Low caste Village*Low Waterlogging				513.8 (559.2)
Low caste Village*Low Flood Prone				335.6 (636.4)
Low caste Village*River				1201.3 (1375.6)
Low caste Village*Canal			9337.0 (14022.3)	-581.8 (685.8)
Observations	1623	670	694	1623
$\overline{R}^2$	0.05	0.035	0.07	0.05

[87]The estimations include all of the controls in the earlier estimations (such as Table 14). We just report the results for the groundwater variables. The sample is all caste groups. The second estimation includes only water buyers. For the two variables measuring groundwater depth in the third estimation, we only have this information for the state of Bihar. The rainfall and groundwater measures come from the Central Water Board of India.

Table 25 - Tobit estimations of crop income/acre with interaction variable[88]

Variable	(1)	(2)	(3)
Buy water*Value of land	-0.03 (0.007)***		
Own pump*Value of land	-0.01 (0.01)		
Low Caste Vill*Buy water*Value of land	0.006 (0.01)		
Low Caste Vill*Own pump*Value of land	0.003 (0.006)		
Buy water*Land own		207.0 (89.9)**	
Own pump*Land own		-116.6 (80.1)	
Low Caste Vill*Buy water*Land own		52.4 (90.9)	
Low Caste Vill*Own pump*Land own		-128.6 (107.4)	
Buy water*Tenant			-1375.7 (600.0)**
Buy water*Landlord			-1278.4 (828.4)
Own pump*Tenant			-2679.5 (1071.5)**
Own pump*Landlord			535.5 (1648.4)
Low Caste Vill*Buy water*Tenant			-1185.0 (627.4)*
Low Caste Vill*Buy water*Landlord			-545.3 (819.8)
Low Caste Vill*Own pump*Tenant			-94.1 (1128.7)
Low Caste Vill*Own pump*Landlord			-56.3 (2026.2)
Low Caste Vill*Own pump	644.9 (1153.3)	466.7 (900.2)	476.9 (840.9)
Low Caste Vill*Buy water	1328.0 (620.4)**	1491.3 (547.2)***	1499.5 (521.1)***
Constant	-3676.2 (485.0)***	-3540.3 (486.8)***	-3975.1 (521.0)***
Observations	1295	1295	1295
$\overline{R}^2$	0.06	0.06	0.06

[88]The sample is the lower castes (BAC, OBC, and SC). All estimations include all of the controls in the earlier estimations (such as Table 14).

Table 26 - Income comparisons by village type[89]

	Crop Income	Equivalence of Means
BAC - High Caste Village	4891.3 (9822.6)	
BAC - Low Caste Village	8285.5 (18694.9)	3394.2 (1528.7)**
OBC - High Caste Village	1166.2 (3310.5)	
OBC - Low Caste Village	2148.4 (6242.1)	982.2 (566.7)*
SC - High Caste Village	391.2 (1348.7)	
SC - Low Caste Village	2310.1 (9893.9)	1918.8 (616.8)***
Upper - Highest Population	11414.7 (31310.1)	2975.8 (2712.2)
Upper - Not Highest Population	8438.9 (13763.2)	
BAC - Highest Population	6456.6 (15321.3)	-556.8 (1342.5)
BAC - Not Highest Population	7013.4 (16748.0)	
OBC - Highest Population	1347.9 (4375.9)	-514.1 (532.3)
OBC - Not Highest Population	1862.0 (5545.2)	
SC - Highest Population	946.2 (3052.9)	-425.5 (491.0)
SC - Not Highest Population	1371.6 (7558.9)	
Upper - Upper Pradhan	16590.4 (41984.9)	4255.3 (4983.8)
Upper - Not Upper Pradhan	12335.1 (16810.0)	
BAC - BAC Pradhan	9923.6 (20769.1)	2836.2 (2027.3)
BAC - Not BAC Pradhan	7087.5 (14793.1)	
OBC - OBC Pradhan	2315.4 (3481.8)	-233.2 (1897.7)
OBC - Not OBC Pradhan	2548.6 (6780.7)	
SC - SC Pradhan	973.6 (3413.0)	-1317.2 (846.0)
SC - Not SC Pradhan	2290.7 (10146.0)	

[89]Standard deviations are in parentheses in the first column and standard errors are in parentheses in the second column. A single asterix denotes significance at the 10% level, double for 5%, and triple for 1%.